EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY

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Thesis presented in partial fulfilment of the requirements

for the degree of

Master of Education in Educational Psychology

in the

Faculty of Education

at

Stellenbosch University

Supervisor: Ms M Perold

December 2015

DECLARATION

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ABSTRACT

Education, both in South Africa and internationally, experiences various challenges with regards to the need for improved teaching and learning. South African education is battling a crisis in mathematics and many learners experience anxiety surrounding the subject. Accordingly, there is a heightened necessity to develop teaching and learning practices that assist learners in being conscious, effective and independent thinkers. Given the impact of anxiety on learners' engagement with mathematics, this study aimed to make a meaningful contribution to the understandings of test anxiety related to evaluations in mathematics. This in turn creates the opportunity for the provision of guidelines in addressing and consequently decreasing its occurrence.

This study was embedded within an interpretive paradigm, employing a qualitative methodological approach, as well as a qualitative research design. Purposive sampling was used to select nine Grade 10 mathematics learners and one mathematics teacher to participate in the study. Data was collected by conducting semi-structured interviews, gathering the exam results of learner participants as obtained over a two and a half year period, and by conducting a creative drawing of the feelings exercise as a manner of externalising the experiences of anxiety to some degree. Furthermore, the qualitative analytical method of thematic analysis was used to analyse the data as this allowed for the identification, analysis and reporting of patterns or themes within the data.

The research findings indicated that learners' experiences and understandings of mathematics test anxiety are guided by emotionality and worry. Various factors related to preparation for an evaluation; physiological and cognitive experiences during an evaluation; and debriefing measures employed upon completion of an evaluation, are influential in learners' overall experiences of anxiety pertaining to evaluations in mathematics. In addition, the study revealed various resources that can by employed as protective factors that may decrease the experiences of anxiety related to mathematics which in turn may have a positive impact on achievement. Furthermore, the study indicated manners in which pedagogical approaches may be adapted so as to aid in the lessening of anxiety surrounding mathematics. Apart from this, findings attained from this study have the potential to inform the direction of

future research oriented toward decreasing learners' experiences of anxiety pertaining to mathematics.

Keywords: Test Anxiety, Mathematical Anxiety, Mathematics Test Anxiety, Adolescents

OPSOMMING

Onderwys, beide in Suid-Afrika en internasionaal, ervaar verskeie uitdagings rakende die behoefte aan verbeterde onderrig en leer. Die Suid-Afrikaanse onderwysstelsel beveg ‘n krisis in wiskunde en baie leerders ervaar angstigheid aangaande wiskunde. Daar is dus ‘n toenemende noodsaaklikheid om onderrig en leerwyses te ontwikkel wat die daarstel van bewuste, effektiewe en onafhanklike denkers teweeg sal bring. Gegee die impak van angs op leerders se omgang met wiskunde, het die studie gepoog om ‘n waardevolle bydra te maak tot die verstaan van toetsangs met betrekking tot evaluerings in wiskunde. Sodoende is die geleentheid geskep vir die daarstel van riglyne om toetsangs in wiskunde aan te spreek, asook te verminder.

Hierdie studie is binne ‘n interpretatiewe paradigma gesetel en het van ‘n kwalitatiewe navorsingsmetodologie, asook ‘n kwalitatiewe navorsingsontwerp gebruik gemaak. Doelgerigte steekproefneming is gebruik om nege Graad 10 wiskunde-leerders en een wiskunde-onderwyser te kies om aan die studie deel te neem. Data is deur middel van semi-gestruktureerde onderhoudsvoering, asook die versameling van die eksamenuitslae van alle deelnemende leerders, soos verkry oor ‘n twee en ‘n half jaar periode, ingewin. Verder is ‘n kreatiewe tekenoefening ook gedoen as ‘n manier om die ervaringe van angs tot ‘n sekere mate te eksternaliseer. Na afloop van die dataversamelingsproses is tematiese analise gebruik om die data te analiseer. Hierdie kwalitatiewe analitiese metode is gekies aangesien dit die geleentheid skep om data volgens patrone of temas te identifiseer en te analiseer.

Die navorsing het aangedui dat leerders se ervaringe en begrip van wiskundetoetsangs grotendeels aangewese is op fisiologiese en kognitiewe komponente. Verskeie faktore wat verband hou met evaluerings; fisieke en kognitiewe ervaringe tydens ‘n evaluering; en die wyses van ontlading na ‘n evaluasie, het ‘n impak op leerders se algehele ervaring van angs met betrekking tot evaluasies in wiskunde. Verder het die studie aan die lig gebring dat verskeie faktore benut kan word om ‘n daling in die voorkoms van wiskundetoetsangs teweeg te bring, asook potensieel ‘n positiewe impak op prestasie te bewerkstelling. Die studie het ook aangedui op watter wyses pedagogiese benaderings aangepas sou kon word om by te dra tot ‘n afname in die voorkoms van angs met betrekking tot

wiskunde. Afgesien van bogenoemde, het die navorsingsbevindinge ook die potensiaal om toekomstige navorsing in die veld van wiskundetoetsangs toe te lig.

Sleutelwoorde: Toetsangs, Wiskundige angs, Wiskunde toetsangs, Adolessente

ACKNOWLEDGEMENTS

My heartfelt thanks go out to the following people who made this work possible.

To an exceptional person, my late mother, you continue to be my source of silent strength. Your kind-hearted nature inspires me in unmeasurable ways.

To my devoted father, thank you for being my guiding compass in navigating the intricacies of striving to reach my dreams.

To my darling sister, your courage and perseverance motivates me in ways I cannot describe.

To all my family and friends, who were with me from the start, I wish to express my sincere gratitude for your support and encouragement throughout this journey.

To all the participants who engaged with the study, I greatly appreciate the opportunity you awarded me in gaining insight into your experiences. Your participation gave this work its meaning.

And finally, to my supervisor, Mariechen Perold, thank you for your guidance and support. I appreciate the manner in which you were cognisant of each word put down on paper, helping to ensure that my intended meaning was portrayed in the text.

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LIST OF ABBREVIATIONS

APA	-	American Psychiatric Association
BIS	-	Behavioural Inhibition System
DBE	-	Department of Basic Education
FET	-	Further Education and Training
MST	-	Mathematics, Science and Technology
ZPD	-	Zone of Proximal Development

CHAPTER 1

CONTEXT AND RATIONALE FOR THE STUDY

1.1 BACKGROUND TO THE STUDY

Both mathematics and anxiety are integral components of human life (Adler, Brombacher & Shan, 2000). Mathematics is utilised in everyday situations rendering it a central element of organised existence (Chikodzi & Nyota, 2010). As a basic human emotion (Huberty, 2009), Freud (1949) conceived anxiety to be consciously perceived by an individual as an unpleasant element associated with fear. Sullivan (1949) states there are clear distinctions between fear and anxiety. The former is a seemingly reasonable response to an objectively threatening event. The latter, however, is considered to be a debilitating response to an event that is not necessarily objectively threatening. Anxiety occurs in all individuals particularly when circumstances are marked by apprehension about uncertain outcomes of an event (Huberty, 2009). When anxiety and mathematics combine in the event of a test within an academic setting, it may cause some learners to experience mathematics test anxiety. As all components of teaching and learning mathematics are influenced by such mathematical anxiety (Mohamed & Tarmizi, 2010), it is a phenomenon worthy of exploration.

In the 1950s test anxiety emerged from a novel research area and has since developed to a field of significant educational interest (Culler & Holahan, 1980). Early work in the field postulated test anxiety as a singular attribute measurable with one-dimensional scales. Interestingly, some theorists at the time perceived there to be at least two indicators of test anxiety. Sarason (1961) proposed that anxieties which interfere with evaluative situations consist of “increased physiological activity” and “self-deprecating ruminations” (pp. 201-202). This notion informed subsequent views emerging in the early 1970s. Test anxiety thus comprises two components traditionally termed emotionality and worry (Cassady & Johnson, 2001).

The emotionality component of test anxiety is evident through physiological responses experienced during evaluative situations. These include heightened

galvanic skin response and heart rate, experiencing panic, nausea and dizziness (Deffenbacher; Hembree; Morris, Davis & Hutchings, as cited in Cassady & Johnson, 2001).

The worry component is synonymous with cognitive test anxiety and consists of individuals' cognitive reactions to evaluative situations, or internal dialogue concerning evaluative situations. The latter can occur prior to, during, and after evaluations. Individuals with high levels of cognitive test anxiety often have thoughts concerning the following: feeling inadequately prepared for tests, extreme worry regarding evaluations, low levels of self-worth and a lack of confidence in their abilities, comparing their own performance to that of their peers, contemplating the consequences of failure, and causing disappointment for their parents (Deffenbacher; Hembree; Morris et al., as cited in Cassady & Johnson, 2001). Being cognisant of the manifestations of test anxiety leads one to deliberate the possible effects this may have for individuals during evaluative situations.

The main impetus for interest in exploring the field of test anxiety has been its relationship with performance measures (Cassady & Johnson, 2001). Path analyses have shown no significant influence between the emotionality component and performance whereas worry and academic achievement seems to be significantly related among adolescents. The latter is also consistently related with declines in performance (Hembree; Williams, as cited in Cassady & Johnson, 2001). As the component with the strongest connection with performance, it is worth examining theories that underpin cognitive test anxiety.

One such theory is the cognitive model which is grounded in findings that individuals with high levels of test anxiety have a high probability to worry about the outcome of the test, make comparisons between their abilities and that of others, or hold the notion that they may not be sufficiently prepared for the test. Accordingly these individuals seem to perform poorly because they are unable to subdue competing ruminations during the evaluation (Sarason, 1984; Schwarzer & Jerusalem, 1992). Easterbrook's (1959) classic work on cue utilisation is consistent with the interference model. It proposes that effective cue utilisation assists individuals by limiting attention to relevant cues only thereby promoting performance. Individuals with high levels of test anxiety either limit their attention to inappropriate cues for the task or are unable

to restrict the range of cues, allowing competing ruminations to interfere with performance (Schwarzer & Jerusalem, 1992).

The traditional cognitive interference model is elaborated on through an information processing view which examines the extended range of cognitive functions that may impede optimal performance. Factors that act as interferences are an awareness of a lack of preparation or inability and failure to effectively process or retrieve necessary information (Desiderato & Koskinen; Lin; McKeachie; Naveh-Benjamin, as cited in Cassady & Johnson, 2001). Thus, the cognitive interference model postulates that declines in performance can be attributed to inadequate processing of test information (Naveh-Benjamin, 1991).

Another theory is the additive model of test anxiety. It emphasises two factors that act in an additive manner to influence test anxiety. These are the individual's trait test anxiety and situation-specific variables (Zohar, 1998). Situational factors include thoughts of being underprepared for the test, viewing the test as posing a threat, and low self-confidence for the assignment (Schwarzer & Jerusalem, 1992; Zohar 1998).

In the work of Kurosawa and Harackiewicz (1995) empirical evidence in support of both the interference and additive models of test anxiety is found. Test anxious students experience interference which leads to a decline in performance. Such interference is predominant mainly in specific conditions where the level of self-awareness during evaluation is high.

Empirical literature indicates that test anxiety is generally associated with lower academic performance (Zeidner, 1998). By distinguishing test anxiety from other forms of anxiety experienced, this paves the way for offering assistance from an educational and psychological framework. It will enable the implementation of meaningful learning strategies, targets, and programs (Reed & Warner-Rogers, 2009). The study was geared toward unlocking the potential hereof.

1.2 MOTIVATION FOR THE STUDY

The motivation for the study was comprised of dual components; one stemming from a personal interest and the other grounded in literature. I will explain each component

and the motivations which flow from it. In so doing I will attempt to provide a blended view of the motivations for the study.

My personal experience is best reflected by the following imagery: *My palms are sweaty, my heart is racing and a nauseous feeling is stuck in my throat. I keep thinking "I'm not good at maths," "I didn't study enough," "I'm going to fail," over and over again. In front of me lies a mathematics question paper. I should pick it up and start doing the calculations yet my vision is blurred, I feel dizzy and am unable to focus.* This was me during high school in a mathematics exam room filled with panic over mere numbers on a page.

As a high school learner I struggled with mathematics. The exact reason why is unbeknownst to me. I achieved good marks in all my subjects and often received the prize for highest marks achieved in my grade. My only downfall was mathematics. Over time I convinced myself that I am not good at mathematics. I have even gone so far as to make conscious decisions not to engage with mathematical activities involving more than basic addition and subtraction in everyday life situations.

Over time I became fascinated by the dynamics surrounding mathematics. Why did I struggle with this subject in high school or dread every test ever written on it? There are others like me yet there are also those individuals who flourish when engaged with mathematics. These fascinations lead me to inquire about the intricacies surrounding anxiety in test situations.

Within literature test anxiety is the most broadly studied specific form of anxiety (Zeidner, 1998). The majority of studies within this field concentrate on adults or university students while few address test anxiety in schools (Gregor, 2005). In addition, most of the studies on test anxiety make use of quantitative methodologies for data collection (e.g. Chinn, 2009; Hunsley, 1987; Núñez-Peña, Suárez-Pellicioni & Bono, 2013). It thus seemed as though there might be a paucity of qualitative research exploring the experience of test anxiety among high school learners.

The study aimed to address the aforementioned gaps in the knowledge on test anxiety by exploring the intricacies of mathematics test anxiety. More specifically, a closer examination was done of mathematics test anxiety among grade 10 high school learners. This particular grade was chosen because it is the first year during

which all learners are required to make a choice between Mathematics and Mathematical Literacy for continuation during the further education and training (FET) phase of their high school careers. Accordingly, learners' understandings of mathematics, as well as their choice between Mathematics and Mathematical Literacy at this stage of their schooling careers influence future choices. As mathematical skills are essential for learners' future achievement, the choices they make at this stage could have far reaching effects. This reiterates the importance of having made grade 10 learners the focus group of the study (Thomas & Furner, 1997).

1.3 THEORETICAL FRAMEWORK

A theoretical framework underlies all research, acting as an intricate fibre interwoven among the intricacies of the research process (Merriam, 2009). As Merriam (2009) so fittingly states, the theoretical framework informs every facet of the research process, from the motivation for the study, to the formulation of the research questions, the chosen methods of data collection and analysis, and ultimately the interpretation and presentation of findings. Given the evident importance of a theoretical framework, I will provide an overview of the theories which amalgamated to form the theoretical framework of the study. An in-depth discussion hereof will be presented in chapter 2.

In social learning theory Albert Bandura (1977) postulates that behaviour is learned through the observation of others. When engaged in observational learning cognitive processes are involved in information processing. This warrants a need to explore the specific role of cognitive processes. Accordingly, Bandura's social cognitive theory serves to elaborate on the aforementioned theory by adding concern with cognitive factors such as self-perceptions, beliefs and expectations (Woolfolk, 2010). Various research studies on the relationship between test anxiety and academic performance have validated that the cognitive domain of test anxiety has a significant impact on academic achievement (Cassady & Johnson, 2002; Morris, Davis & Hutchings, 1981). Due to its emphasis of cognitions on learning and the importance of thought processes on test anxiety and achievement, social cognitive theory formed the main theory used to underpin the study.

Current social cognitive theory describes the dynamic interchange between three kinds of influences: social (environmental), self (personal) and achievement outcomes (behavioural), referred to as the triarchic reciprocal causality system (Woolfolk, 2010). These influences all form part of an individual's world in which they influence and are influenced by each other.

The first of the three influences emphasise the role of other individuals such as teachers, parents, siblings and friends, as well as discourses in the public domain which all serve as models that impact learners' ideas and behaviour through their own beliefs and actions (Woolfolk, 2010). This notion is reminiscent of Vygotsky's theory of social constructivism which postulates that meaning is constructed through social interaction (Burr, 2003), i.e. when engaging with one's environment.

The second influence centres on personal factors such as an individual's sense of self-efficacy which entails beliefs about own ability to successfully accomplish a specific task (Woolfolk, 2010). The key question is thus "Can I do it?" not "Are others better than I am?" (Woolfolk, 2010, p. 350). This is an important theoretical component as literature indicates that some learners experience interfering cognitions of comparing their performance to that of their peers during evaluative situations (Deffenbacher; Depreeuw; Hembree; Morris et al., as cited in Cassady & Johnson, 2001). Personal factors that might influence emotional experiences of anxiety could also emanate from a biological point of view. A brief review of biological influences on anxious responses to stressful situations will hopefully add to a rich description of this phenomenon and thus embrace the sought understanding of it.

The last of the three influences encompasses notions of individual's behavioural capabilities and how they regulate their own lives based on what motivates them. Motivation is sourced from either internal – or external sources, or both (Woolfolk, 2010). It may be conceived of as an academic enabler (Linnenbrink & Pintrich, 2002), thereby making it a factor that can potentially have a major influence in the experience of mathematics anxiety (Hlalele, 2012).

In turn, parallels can be drawn from the three influences of the triarchic reciprocal causality system to the learning-testing cycle and its three phases: preparation, performance, and reflection to assist in forming explanations for the thoughts and

patterns of behaviour pertaining to test anxiety (Cassady, 2004). It is evident that by looking at both cognitions and behaviours as sourced from various influences in a learner's life, this assists in forming a more comprehensive conceptualisation of test anxiety.

Social cognitive theory was thus utilised to assist in guiding the research process and ultimately provide a framework to explain findings concerning human adaptation, learning, and motivation with specific reference to social, emotional, cognitive, and behavioural competencies regarding the manner in which learners regulate their own lives (Woolfolk, 2010), specifically as pertaining to mathematics test anxiety. Vygotsky's work on social constructivism and Cassady's notions on the learning-testing cycle served to enhance Bandura's ideas on social cognitive theory.

1.4 THE AIMS OF THE RESEARCH

The literature reviewed reveals test anxiety to be a real and serious phenomenon, known to psychology and education since the 1950's. It interferes with evaluative situations (Sarason, 1961) and is associated with lower academic performance (Zeidner, 1998), thereby rendering it a worthy field of inquiry. As such, I aimed to explore the phenomenon of test anxiety within the field of mathematics as experienced by adolescent learners.

The primary research question was:

> How do grade 10 learners experience and understand mathematics test anxiety?

With the sub-questions:

> What factors might contribute to the experience of anxiety related to evaluations in mathematics?
>
> When does anxiety not influence evaluations in mathematics?

1.5 METHODOLOGY

1.5.1 Research paradigm

Paradigms are comprehensive frameworks of interrelated practice and thinking (Terre Blanche & Durrheim, 1999) constituting a particular manner of looking at the world (Mertens, 1998). A research paradigm guides the researcher's understandings of ontology and epistemology and also guides methodological decisions pertaining to methods of data collection, observation and interpretations (Durrheim, 1999). This qualitative study is categorised within an interpretive paradigm as it assumed that the anxiety individuals experience form part of their subjective world.

An essential component of qualitative research is that it allows the researcher the opportunity to gain a better understanding of the subjective meanings of everyday experiences and practices of individuals (Bruner; Sarbin, as cited in Flick, 2009). It also enables the researcher to gain insight into the viewpoints of individuals as it stems from their social backgrounds thereby rendering them the main source of knowledge (Flick, 2009). The aim of the study was thus to describe and understand the subjective reasons and meanings surrounding adolescents' test anxiety pertaining to mathematics.

1.5.2 Research design

The research design employed was a basic interpretive design (Merriam, 1998) applying thematic analysis (Braun & Clarke, 2006). This design is characteristically "exploratory, fluid and flexible, data-driven and context-sensitive" (Mason, 2002, p. 24). Employing this design and method of data analysis supported the primary goal of the study which was to gain in-depth descriptions and understandings of a specific human experience, namely mathematics test anxiety. A basic interpretive design complemented this exploration as it allowed for insight to be gained into the phenomenon under inquiry from an insider perspective, i.e. from the viewpoint of the individuals themselves (Babbie & Mouton, 2001).

1.5.3 Sampling

Purposive sampling was used to select participants to partake in the study. This technique enabled focus to be placed on particular characteristics of a population

that were of interest, namely the experience of test anxiety pertaining to mathematics, which in turn enabled the researcher to answer the proposed research questions (Laerd, 2012). The theoretical population for this study was sourced from a Western Cape high school. Grade 10 learners who chose mathematics as subject was approached to volunteer to partake in the study. The researcher also requested that the mathematics teacher take part in the study and share her knowledge on the topic of inquiry. This method of sampling fit the aim of the research in developing a deeper understanding of a specific phenomenon in terms of particular individuals' definition of the world (Neuman, 1997; Terre Blanche & Durrheim, 1999).

1.5.4 Methods of data collection

A key feature of qualitative research designs is openness to multiple sources of data. Utilising a multi-method approach allows the researcher to enhance the richness of knowledge gained (Babbie & Mouton, 2001).

The study utilised basic individual semi-structured interviews as the main form of data collection. In support hereof, an interview was held with the participants' mathematics teacher. As another source of data, the participants' mathematics exam results, as obtained over a period of two and a half years dating back to grade 8, were also consulted. The latter data source was incorporated in order to explore the argument of Ho et al. (2000) that in the long term, anxiety pertaining to mathematics result in lower academic performance in the subject. It further enabled the identification of possible patterns between participants' verbal responses regarding the level of test anxiety experienced and their achievement. Creative methods such as drawing of the feelings before a mathematics test was also incorporated in the data collection process as a way of externalising the problem to some degree.

These methods allow for triangulation thereby minimising biases that stem from single methodologies while enhancing the validity and reliability of the research (Babbie & Mouton, 2001). In a further attempt at maintaining methodological rigor, member validation formed an intricate component of the research process. The data obtained during the aforementioned data collection processes was presented to the participants to gain their appraisal of the work (Crilly, Clarkson & Blackwell, 2006). Furthermore, care was taken to differentiate between emotional responses evoked

pertaining to test anxiety and other forms of anxiety, thereby enhancing the trustworthiness of the research. See the section on *Ethical Considerations* for more details.

1.5.5 Data analysis

Within qualitative research data collection and analysis should occur concurrently (Merriam, 1998). Data has been thematically analysed in order to identify themes (Berg, 2009; Sagor, 2005) using a coding scheme (Azevedo, 2009; O'Hanlon, 2003) to reflect patterns which may produce information to answer the research questions. The categorisation of identified patterns remained tentative as input of new data is continuous and necessitate flexible interpretations (O'Hanlon, 2003). Once this process was concluded, a holistic interpretation of the findings was made (Holliday, 2007). The findings will be discussed against the background of the literature review and by taking the theoretical framework into consideration.

1.6 ETHICAL CONSIDERATIONS

Wassenaar (2006) provides a framework of four ethical principles for social science research. Firstly, the principle of non-maleficence signifies avoiding or minimising harm and negative influence for participants. Secondly, the principle of beneficence postulates that the benefits of the research for those involved should be increased. Thirdly, autonomy and respect for the dignity of participants should be upheld. Fourthly, according to the justice principle all parties must be treated in a fair and equitable manner. I have strived to ensure that these principles are maintained throughout the research process.

Participation in the study was voluntary. Participants were well-informed as to the purpose, methods and intended use of the research. Accordingly, individuals had a clear indication of what their participation in the research would entail prior to making a decision regarding their participation in the study. Written forms of informed consent were obtained from the participating learners, their parents, the teacher and any parties who formed part of the research process. Furthermore, the identities of participants were protected by using codes as a prediction could not be made of the possible outcomes if their identities are revealed. In so doing, the first principles of

non-maleficence, as well as elements of the third principle of autonomy and respect, were adhered to.

I communicated to participants that their involvement in the study is appreciated and that they may potentially make a valued contribution to scientific knowledge. Accordingly, we worked collaboratively towards the construction of knowledge geared toward both understanding the research phenomenon on a personal and more general level. This aided to address the second principle of beneficence.

Participants were made aware of their right to refuse participation or to withdraw from the study at any point during the data collection process without encountering negative consequences to themselves. I attempted to avert any sense of coercion by assuring participants that even after they had volunteered; they may still withdraw from the study and were not bound to continue. These actions served to further enhance the third ethical principle of autonomy and respect.

The personal views of participants were respected and the boundaries they set were not infringed upon. I also presented the findings to each participant and allowed them the opportunity to give feedback through member validation, thereby ensuring that my representation of the information they shared was as close as possible to the meanings they expressed. By treating participants and the knowledge they shared in a fair and equitable manner, the study adhered to the fourth ethical principle of justice.

As the topic of test anxiety and particularly in the field of mathematics evaluations, were discussed, possible emotional responses might have been elicited during such discussions. In addition, as manifestations of different forms of anxiety experienced by learners may have presented itself, care was taken to be vigilant of such anxiety, particularly general anxiety. In striving towards non-maleficence, arrangements for containment and follow-up of said potential emotional responses were made. The school has a registered psychologist on the staff and she was approached in this regard as soon as the necessary permission was obtained from the principal. Her presence was also requested during interviews.

1.7 CONCEPTUAL ANALYSIS

In order to understand and engage with the content of this academic discussion it is imperative that certain key terms be defined.

1.7.1 Test anxiety

As a multidimensional construct, test anxiety has been defined as “the set of phenomenological, physical, and behavioural responses that accompany concern about possible negative consequences or failure on an exam or similar evaluative situation” (Zeidner, 1998, p. 17). A child who experiences test anxiety may spend too much time thinking about how bad it would be to fail that they are unable to focus on finding solutions to the problem and ultimately fail the test (Mash & Wolfe, 2005).

1.7.2 Mathematical anxiety

Mathematical anxiety encompasses feelings of panic, paralysis, helplessness and mental disorganisation which some individuals experience when it is necessary for them to solve a mathematical problem (Richardson & Suinn; Tobias, as cited in Núñez-Peña et al., 2013). These feelings of tension and fear impede on the individual’s ability to manipulate numbers in various situations (Khatoon & Mahmood, 2010; Leppavirta, 2011; Newstead, 2006; Perry, 2004) and ultimately result in an irrational fear of mathematics (Tsanwani, as cited in Hlalele, 2012) which manifests as an avoidance of mathematics, ensuing failure to learn mathematics skills, and negative school and career related decisions (McAnallen, 2010).

1.7.3 Mathematics test anxiety

Within academic literature the terms test anxiety and mathematical anxiety are used separately although it does address the manifestation of anxiety surrounding tests in mathematics, as alluded to in the work of Mohamed and Tarmizi (2010). On less academically inclined platforms such as *Math Goodies* that offer suggestions for dealing with mathematics test anxiety, the term is used as a cohesive unit (Math Goodies, 1998). In this academic discussion, the term mathematics test anxiety is used to refer to combined components of test anxiety and mathematical anxiety, as defined individually in the preceding section.

1.7.4 Interchangeable term usage

Throughout the discussion the terms test, exam and evaluation are used interchangeably to refer to an evaluative situation. Similarly, references to a teacher are indicative of a mathematics teacher.

1.7.5 Adolescents

Adolescents, as defined by the World Health Organisation (2013), are individuals between the ages of 10 and 19. From this age group the study focused specifically on learners in grade 10.

1.8 SUMMARY OF CHAPTER

As the entry pages to the thesis, this chapter presented both the background to the study, as well as the research aims and design. The remainder of the thesis will be structured so that each chapter focuses on a specific dimension of the research process. An overview of the literature on test anxiety pertaining to mathematics will be provided in chapter 2. Hereafter, a detailed report of the research design and methodology will be contained in chapter 3. The findings from the data collection process, as well as a discussion of the research findings, will be presented in chapter 4. Chapter 5 will contain concluding remarks on the research findings; recommendations for both learners and teachers in mathematics; limitations and strengths of the study; and possibilities for future research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The intent of a literature review is to explore previous research done in the field of interest (Babbie & Mouton, 2001) in order to guide the planning and execution of a research study (Henning et al., as cited in Oswald, 2010; Babbie & Mouton, 2001). In addition, the literature review contextualises the current study within existing knowledge on the topic and directs the way for the discussion and arranging of the research findings within this context (Kaniki, 2006), thereby identifying a "niche to be occupied by a particular research study" (Henning et al., as cited in Oswald, 2010, p. 28).

In chapter 1 I described the importance of a theoretical framework in guiding the research process. I positioned the study within social cognitive theory and provided an overview hereof as well as other theories which serve to enhance the central theory. This chapter aims to synthesise available literature on aspects of these theories into a conceptual framework for exploring the intricacies of test anxiety pertaining to mathematics and in so doing provide an in-depth discussion of literature relevant to the topic of inquiry.

The discussion will commence by exploring the origins of social cognitive theory as it stems from social learning theory which in turn is grounded in a school of thought focused on explaining human behaviour. Hereafter, focus will shift to the concerns with cognitive factors central to social cognitive theory. Next, the triarchic reciprocal causality system in which a dynamic interchange occurs between three kinds of influences will be described. The understanding and significance of each influence will be enhanced by another supporting theoretical aspect and set out as follows: social influences will be pared with Vygotsky's work on social constructivism, aspects of self-efficacy will support notions of self-influences, and an individual's behavioural capabilities and motivation will be matched in order to determine how these influence

achievement outcomes. To conclude the discussion, the three influences of the triarchic reciprocal causality system will be linked with the learning-testing cycle.

2.2 A THEORETICAL FRAMEWORK FOR EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY

2.2.1 Traditional views on human behaviour

Over time many theories have been proposed to explain human behaviour. The specific focus of theorists' work is guided by what they believe individuals to be and what they view as constituting human nature. These conceptualisations influence which determinants and mechanisms of human functioning are to be explored and the paradigms used to collect data for this purpose. These factors all serve to shape the particular theory (Bandura, 1977; Bandura, 1986).

Behaviourism, as a school of thought focused on explaining human behaviour, will form the point of departure in tracing the foundation of the central theory of this study. A behaviouristic view holds that behaviour is presumably prompted by stimulus conditions prior to the behaviour and maintained by reinforcing conditions after the behaviour (Bandura, 1977; Bandura 1986). The agency of action is thus located in environmental forces as opposed to internal events. This radical approach to behaviourism is based on the presumption that inner events transmit but cannot create influences. Therefore, this view does not deny that inner influences are connected to behaviour; it merely regards it as subservient as these inner influences are assumed to originate in external stimuli (Bandura, 1986).

Traditional theories of learning propose behaviour to be the result of directly experienced response consequences. In contrast to traditional learning theory, Bandura (1977) postulated that direct reinforcement could not sufficiently explain all types of learning and elaborated on this view by adding a social element. In accordance, behaviour is conceived of as the result of directly experienced response consequences whereby learning can also occur vicariously through the observation of others' behaviour and its consequences for them. This process enables an individual to acquire patterns of behaviour by virtue of observation. Similarly, individuals can develop emotional responses by observing the affective responses of

others (Bandura, 1977). Although an influential theory of learning and development within the behaviourist perspective, Bandura later came to the realisation that imitation and observation were still insufficient in explaining how individuals learn. It is a process far more complex than initially thought (Malone, 2002).

2.2.2 Changes in conceptualisations of human behaviour

Traditional conceptualisations of human behaviour have been criticised for being too circumscribed and hindered by mechanistic models of understanding. However, progress has occurred in understandings of psychological processes, which renders it necessary to re-examine some of the fundamental assumptions about the acquisition and regulation of human behaviour (Bandura, 1977).

The value of a theory resides in the power of the processes it produces to effect psychological changes. Psychological approaches which consider the attainment of self-awareness crucial in producing enduring behavioural changes in turn attribute behaviour to the operation of internal impulses. Individuals' impulses manifest in different forms. By labelling these impulses, the underlying determinants of their behaviour are made conscious. In order to understand human behaviour the theories used must be able to accurately identify the determinants hereof, as well as the intervening mechanisms responsible for any changes which might occur (Bandura, 1977).

Determinants and intervening mechanisms which bring about change in human behaviour are not only due to an internal influence. Research shows that the response patterns of individuals that are often attributed to internal causes can be induced, eliminated, and reinstated by various external influences. Accordingly, determinants and intervening mechanisms which bring about change in human behaviour can be attributed to both internal and external influences (Bandura, 1977).

The cognitive capacity of humans is an important factor that determines both how individuals are affected by their experiences and the future directions their actions may take (Bandura, 1977). Piaget conceived of cognitive development as a process of adaptation encompassing various stages. He proposed that humans organise, understand, and adapt to continuous information received from their environment. This is done by assimilating new information that can fit into the existing, by adjusting

the existing so as to accommodate new information, and through the continuous interaction between these informational sets in an attempt at reaching equilibrium. The cognitive developmental stage of the adolescent participant group of this study, termed the formal operational stage, is characterised by abstract thinking. The educational implications hereof are that teaching and learning should encompass active, exploratory processes, as well as an emphasis on progressive potential of that which can be attained, as opposed to limitations of what may not yet be possible (Donald, Lazarus & Moolla, 2014). Against this theoretical background, Bandura elaborated on his theory of learning to include cognitive processes such as thinking, language, memory, and anticipating and evaluating consequences (Malone, 2002). Social cognitive theory encapsulates these cognitive processes and will be more closely examined in the next section.

2.3 UNDERSTANDINGS OF COMPLEX HUMAN BEHAVIOUR

2.3.1 Social cognitive theory

> "A theory that denies that thoughts can regulate actions does not lend itself readily to the explanation of complex human behaviour."
>
> (Bandura, 1977, p. 10)

As social cognitive theory acknowledges the role of cognitions as pertaining to human behaviour, the above quotation serves to reiterate the appropriateness of social cognitive theory as the central theory for this study. A social cognitive perspective will be presented as a theoretical framework for analysing human thought, motivation, and action and more specifically, as it pertains to anxiety surrounding mathematics evaluations.

Social cognitive theory employs an interactional model of causation termed the triarchic reciprocal causality system wherein social (environmental) events, self (personal) factors and achievement outcomes (behaviour) operate as interactive determinants of each other (Bandura, 1986; Woolfolk, 2010). Determinism entails the production of effects by certain factors. This occurs in a reciprocal manner whereby mutual action occurs between contributing causal factors (Bandura, 1986). This interactional process is illustrated in Figure 2.1.

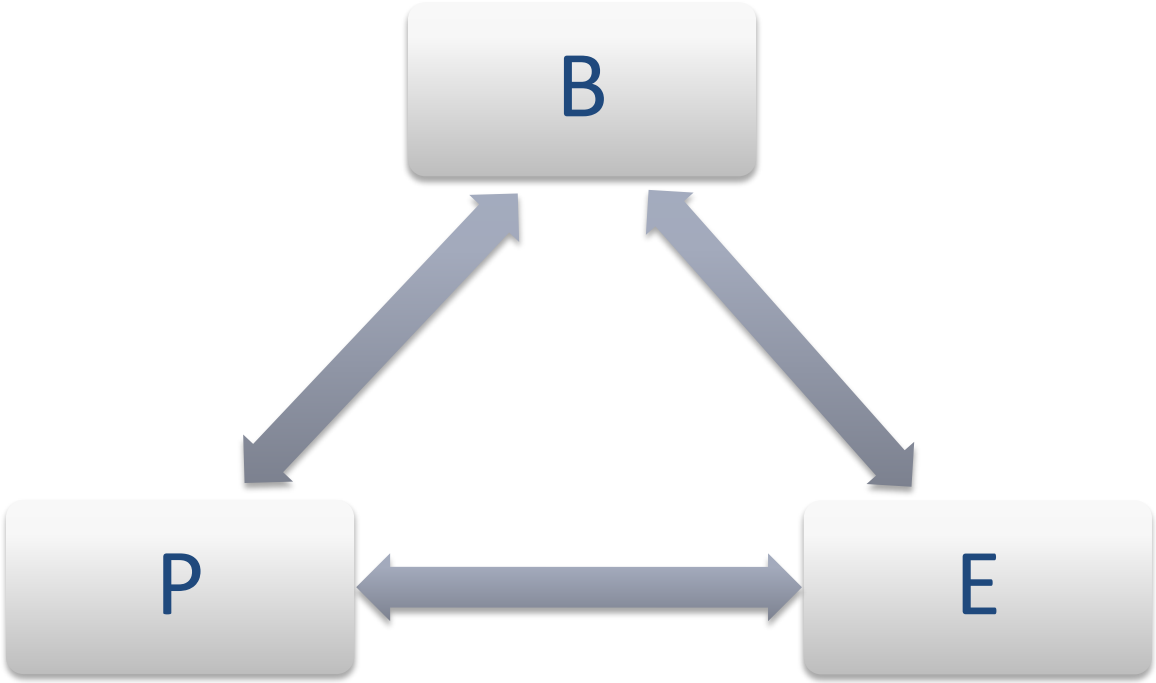

Figure 2.1: Triarchic reciprocal causality system - Within this relationship B represents behaviour; P the internal personal factors in the form of cognitive, affective, and biological events; and E the external environment (Source: adapted from Bandura, 1986).

Within this reciprocal system there is no equal proportion in strength or influence regarding direction or impact of these three influences. Nor do they occur simultaneously. Rather, their mutual effects occur sequentially and vary according to different activities and individuals (Bandura, 1986). The continuous reciprocal interaction between individuals and their environment mean that one influences the other and this enables individuals to exercise some control over events as well as set limits of self-direction. Accordingly, individuals are neither driven by inner forces nor powerless objects controlled by external stimuli in an automatic manner. In a social cognitive view the triarchic reciprocal causality system thus serves to explain human behaviour (Bandura, 1977; Bandura, 1986).

The aforementioned argument necessitates that conceptualisations of human behaviour address both personal and environmental determinants. When exploring personal determinants of individuals' psychological functioning, a central role is accorded to cognitive, vicarious, self-regulatory, and self-reflective processes.

Individuals' thought processes are valuable in comprehending the environment. Cognitive causation forms part of individual affect and action in varied manners depending on the social origins of thought and the mechanisms by which knowledge is transformed into action. Individuals are self-reactors whereby internal standards and evaluative reactions to one's own performances influence self-regulatory activities pertaining to motivation and action and in this way highlight the capability of forethought. Individuals' behaviour is thus directed toward goals and outcomes projected into the future (Bandura, 1986).

Within an interactional perspective it is necessary to devote attention to the varied manners in which cognitive causation forms part of individual affect and action, what the social origins of thought is, and the mechanisms by which knowledge is transformed into action. In essence, these are reflected in the nature of individuals which forms the main principles of the theory and is defined in terms of a number of capabilities (Bandura, 1986).

The main principles of social cognitive theory include "learning by vicarious reinforcement (modelling, imitation, and identification), symbolic activities (language and gestures), forethought activity (cognitive anticipation of consequences), self-regulatory capabilities (goal setting and self-direction), self-reflecting capabilities (self-evaluation), self-efficacy (confidence), and self-reinforcement" (Bandura, 1977; 1986; Bandura; Bandura & Kupers; Bandura & Mischel; Bandura & Whalen; Muuss, as cited in Malone, 2002, p. 10). These principles will be explored as it links with the triarchic reciprocal causality system.

2.3.2 Determinants within the triarchic reciprocal causality system

2.3.2.1 Social (environmental) events

The social environment exerts influence over an individual in various manners. It illustrates the appropriateness and attainability of certain aspirations, while others result in disappointment and frustration; it also conveys an environment-specific common-sense (Cann, as cited in Hlalele, 2012). In addition, social learning variables concerning mathematics as subject influence the learner taking it. These include public discourse on the subject; the design, topics, manner of instruction and conduct of the teacher; availability or lack of feedback; remarks made by parents and

significant others; and the presence or absence of role models. All these variables can serve to either encourage or discourage learners' favour or disapproval of mathematics. The notions of these influences are consistent with social learning theory; one of the foundations of the central theory of this study (Hlalele, 2012; Orcutt & Schwabe, 2012).

Public discourses on the importance of mathematics as a foundation for any kind of success in the world abound in popular media and are strengthened by declarations from people in power positions regarding the need for knowledge in this field for South Africa as a developing country. According to our country's former minister of basic education, Naledi Pandor, mathematics opens doors. Various fields such as academia, finance, high-tech industries, physics and sciences are dependent on mathematical expertise and its accompanying analytical problem-solving skills. Therefore, Pandor (2004) stated that all learners should engage with mathematics so as to pave the way to good graduate and career opportunities. Furthermore, the Department of Basic Education (DBE) reports improvements in mathematics and science competencies of grade 9 learners between the time period 2002 and 2011, as evident in the Trends in Mathematics and Science Studies benchmark report (Ngubeni & Mawson, 2014). A recent statement made by the current minister of basic education, Angie Motshekga, serves to elaborate on the aforementioned. She postulates that the DBE is in the process of revising its Mathematics, Science and Technology (MST) strategy. This document holds that strategies should be put in place to increase the uptake in pure mathematics by learners; includes plans to ensure mathematics is offered as subject in all schools across the country; and that learners be granted the opportunity to take gateway subjects such as mathematics, science and technology (Department of Basic Education [DBE], 2014) as these subjects are deemed central to a successful future (Pandor, 2004). The office responsible for this strategy is at present fully operational (DBE, 2014).

The teaching-learning interactions between the mathematics teacher and the learners form part of social and affective processes. When these interactions are constrained to a path of learning whereby ritual rule following of normative routines and rule-based strategies take place, learners may depend on arbitrary facts that they learned in isolation. Classroom interaction is often limited which does not create

the space for learners' questions to be asked nor answered, and the information conveyed may be limited and confusing. Under the façade of these teaching strategies failure is often repeated and anxiety perpetuated, which in turn results in an identity of failure in mathematics (Levine, 2008). Such an identity manifests from reciprocal interactional influences between the mathematics teacher and the learners and is thus co-constructed by the parties concerned. In contrast, a more productive path of learning is one that is open to skilful, agentive and explorative performance which allows for the acquisition of both procedural and conceptual knowledge (Heyd-Metzuyanim, 2013; Mulligan, 2011). Essentially, this highlights the importance of instruction as an environmental influence on learners' identity in mathematics as well as the construction of meaning through social interaction as described in Vygotsky's theory of social constructivism (Burr, 2003). All these factors in turn influence learners' behaviour and performance in the subject during evaluative situations.

Anxiety is another factor that impacts on learners' performance in mathematics as it is accompanied by intrusive thoughts and worries which cause a decrease in the efficacy of a learner's working memory. As such, it distracts the individual from the mathematical task at hand as the learner experiences difficulty in thinking logically. What follows is an increase in errors and decreases in competence, completion rates, academic performance, and subsequently in a sense of self-efficacy in the subject (Ho et al., 2000).

Against the backdrop of teaching-learning interactions, teacher dynamics and learner experiences, it is useful to highlight the role that the mathematics teacher can play regarding anxiety within their subject area. The mathematics teacher should have an awareness of the prevalence of learners' mathematics anxiety, as well as its effects on motivation and achievement (Hlalele, 2012). Mathematics is applicable not only inside but also outside of the classroom as it forms an intricate part of everyday life. The mathematics teacher should further assist learners in realising this connection between mathematics in an academic setting and its utilisation in everyday situations which make it a central element of organised existence (Chikodzi & Nyota, 2010; Furner & Berman, 2003).

As a society we form part of a competitive world that equates personal progress with quality of performance. It follows that parents aspire for their children to achieve as

high a level of performance as possible. This aspiration for a high level of achievement exerts pressure on learners, as well as broader systems which include teachers, schools and the educational system. As a result, these parties concerned make conscious efforts to assist learners in achieving optimally in their scholastic activities (Sridevi, 2013). One scholastic activity that evokes immense anxiety for many learners is a test. Learners with great potential frequently experience high levels of anxiety during evaluative situations which may result in poor performance. Already upon entering the school context the learner carries anxieties which is then either increased or decreased depending on academic dynamics and has a corresponding influence on their academic performance (Sarason, as cited in Sridevi, 2013). This reiterates the work of Ho et al., (2000) which states that higher levels of anxiety pertaining to mathematics corresponds with lower levels of performance, indicating a negative correlation between the two entities. It can be deduced that decreased anxiety levels surrounding mathematics would be consistent with improvements in mathematics achievement (Hembree, 1990).

The aforementioned served to highlight the social influences within the triarchic reciprocal causality system. The discussion will now progress to the influential personal factors experienced by individuals.

2.3.2.2 Self (personal) factors

As alluded to earlier, within the social cognitive perspective the nature of individuals can be defined through various basic capabilities. These are termed symbolising-, forethought-, vicarious-, self-regulatory-, and self-reflective capabilities. These capabilities form part of the second influence of the triarchic reciprocal causality system, namely self (personal) factors (Bandura, 1986).

The capacity to use symbols enables individuals to alter and adapt to their environment. Symbols allow individuals to process and transform momentary experiences into internal models and offer a way to give meaning, form, and continuance to experiences. These experiences provide knowledge on which individuals draw to direct future action. Action occurs not by simply enacting options and possibly enduring the consequences of mistakes but rather by trying various options symbolically and discarding or retaining them based on estimated outcomes

prior to actually taking action. However, individuals are not always objectively rational in such dealings as reasoning skills may be underdeveloped or used ineffectively. When employing aforementioned reasoning skills individuals may make faulty judgements when acting based on misconceptions or insufficient information. In this way, thoughts can possibly be a source of failure or distress (Bandura, 1986). The intrusive thoughts which are synonymous with cognitive test anxiety accompany mathematics anxiety and shift focus away from the immediate mathematic activity learners are engaged in, thereby causing declines in performance (Hembree, 1990; Williams, as cited in Cassady & Johnson, 2001; Ho et al., 2000).

Forethought is a manner in which individuals regulate behaviour. The capability to do so is rooted in symbolic activity. Rather than reacting to the environment or being steered by past experiences, individuals intentionally and purposively choose behaviour. This is done by anticipating the consequences of prospective actions, setting goals, and planning courses of action to be taken. These activities constitute a cognised future. This means that goals and outcomes that are projected into the future allow the future to acquire causal efficacy as it is represented cognitively in the present. In this manner cognised futures can be precursors to actions (Bandura, 1986), and may serve as a motivational factor which guides the manner in which individuals regulate their lives (Woolfolk, 2010).

Individuals possess few inborn patterns and therefore have the vicarious capability to learn from others (Bandura, 1986). In so doing they skip the gradual process of acquiring behavioural patterns gradually through trial and error but rather do so by observing others' actions and the consequences it has for them. Many complex skills are mastered through this process of modelling. Based on the notion of modelling, links are evident between self-influences and aspects of social influences such as teaching-learning interactions and the expectations of parents, as discussed in the previous section (Bandura, 1986; Woolfolk, 2010).

Among the determinants of behaviour are self-produced influences. Individuals employ internal standards and self-evaluative reactions in response to their own actions to motivate and regulate behaviour. When combining influences over the environment and self-regulatory functions individuals are able to exercise self-directedness in their behaviour. Through the combination of all these influences –

environmental, cognitive, and incentive for efforts, individuals are able to make causal contributions to their own motivation and actions (Bandura, 1986). Changing perceptions about individual ability can assist learners in reducing anxiety which in turn will have a positive influence on their performance in mathematics tests and other related activities (Hembree, 1990; Mashego, 1993). This is consistent with the cognitive model which proposes that if individuals alter their dysfunctional thinking to more realistic and adaptive perspectives, improvements in their emotional state and behaviour will follow (Beck, 2011).

Bandura (1986) proposes that the capability for reflective self-consciousness is characteristically human. Individuals are able to think about and analyse their experiences in a manner that allows them to derive basic knowledge pertaining to themselves and their environment. This process awards them the opportunity to reflect on, evaluate, and alter their own thinking. Self-perceptions which develop through reflective processes enable individuals to form judgements about their own capabilities and these in turn determine what they choose to do, the level of investment put into activities, the length of perseverance when confronted with disappointment, and whether tasks are approached in either an anxious or self-assured manner (Bandura, 1986). Rossnan (2006) elaborates on this view by demonstrating its applicability to anxiety surrounding mathematics. He states that learners' prior negative experiences in the subject, in either classroom or home context, will form part of their reflective framework on the matter. This in turn may lead to the development of anxiety concerning mathematics. Such anxiety manifests as an effective response that result in fear and apprehension which interferes with the individual's ability to manipulate numbers and to solve mathematical problems in a variety of settings, both ordinary and academic. It may further result in avoidance of mathematics, followed by failure to acquire mathematics skills, and ultimately negative school-related and career decisions (Khatoon & Mahmood, 2010; Leppavirta, 2011; McAnallen, 2010; Newstead, 2006; Perry, 2004).

Components of the above-mentioned capabilities amalgamate to impact on an individual's beliefs about their personal efficacy and constitute an imperative part of their self-knowledge (Bandura, 1997). Accordingly, the following section is dedicated

to exploring personal levels of self-efficacy and its role in the experience of anxiety surrounding evaluations in mathematics.

The focus of psychological theories is often on the acquisition of knowledge or performance of response patterns. This view neglects the process involved in the interrelationship between knowledge and action which is mediated by thought. An important component of the study is to gain insight into this area and in so doing attempt to bridge the gap in knowledge (Bandura, 1986).

Gaining such insights necessitates an exploration of how individuals judge their capabilities and self-perceptions of the manner in which their motivation and behaviour is affected by own efficacy. Perceived self-efficacy is a judgement executed by an individual pertaining to their capability to achieve a certain level of performance (Bandura, 1986). Cognitions regarding the perception of self, beliefs and expectations are central to social cognitive theory (Woolfolk, 2010) and fits with the kind of ruminations that occur when experiencing test anxiety (Sarason, 1984; Schwarzer & Jerusalem, 1992). The works of Deffenbacher, Depreeuw, Hembree and Morris et al. (as cited in Cassady & Johnson, 2001) support this view by postulating that learners often compare their performance during evaluative situations to that of their peers. This occurrence is in stark contrast to the questions Woolfolk (2010, p. 350) propose as indicative of high levels of self-efficacy, namely “Can I do it?” and not “Are others better than I am?”

Self-efficacy is a major aspect of an individual’s self-knowledge and is both product and construct of experience. Beliefs about own self-efficacy is constructed from four sources of information which are conveyed either in an enactive, vicarious, persuasive or physiological manner (Bandura, 1997).

Enactive mastery experiences offer authentic evidence as to whether or not an individual has what it takes to succeed, making it the most influential source of efficacy information. High levels of self-efficacy are the result of performance successes. Once individuals believe they can succeed, they are able to persevere when confronted by adversity and are able to recover from setbacks, as well as be prepared to take risks in attempting more difficult tasks. Conversely, the experiences of performance failures may bring about low levels of self-efficacy. The latter is

particularly significant when failures occur during the initial phases of an event and are not reflective of a lack of effort or opposing external conditions (Bandura, 1997).

Vicarious experiences are mediated through modelled attainments and serve as a mechanism for promoting self-efficacy. Modelling offers a way to alter perceptions of efficacy particularly under circumstances when an individual has had few prior experiences from which to deduce their capabilities. In the absence of direct knowledge an individual is more likely to rely on modelled indicators (Takata & Takata, as cited in Bandura, 1997). These indicators may be modelled by significant others such as teachers and parents as discussed in the section on social influences.

Verbal persuasion stems from social influences. Significant others can potentially strengthen an individual's beliefs about their own capabilities by expressing conviction in their abilities. When an individual is verbally persuaded into a realistic belief about their ability to master a given task, they are more likely to produce effects through their actions. Through the mobilisation of effort, a diversion is created from personal deficiencies. Persuasion, however, should not be unrealistic for that may result in failure and subsequently discredit the persuaders, as well as weaken the individual's beliefs in their capabilities (Bandura, 1986).

Physiological and affective states provide an individual with somatic information regarding capability, strength and vulnerability. It furthermore includes domains of health functioning, physical accomplishments, and coping with stressors. The latter domain is of particular relevance as individuals often regard their physiological reactions during stressful events as indicators of vulnerability or dysfunction (Bandura, as cited in Bandura, 1997).

Persistent and excessive worry and anxiety about various domains, including schoolwork, may lead to the experience of certain physiological and affective states. More specifically, physical symptoms such as restlessness; muscle tension; difficulty concentrating or mind going blank; and sleep disturbances may be experienced. These physical experiences form part of the diagnostic criteria for generalised anxiety disorder (American Psychiatric Association [APA], 2013). Therefore, individual's experiences hereof would warrant a closer examination into the matter.

Another physical experience worthy of mentioning is panic attacks. It involves an abrupt surge from a calm state to an anxious state. This shift in affective and physical state may be accompanied by the following experiences: “an accelerated heart rate; sweating; trembling; shortness of breath; feelings of choking; chest pain; nausea; feeling faint; chills or heat sensations; numbness or tingling sensations; fear of losing control and/or dying” (APA, 2013, p. 214).

A view of one’s reactions to stressful situations as inefficacious may lead to further generations of stress by anticipating self-arousal. Accordingly, any effort to address such emotional reactions should incorporate mastery experiences. This can increase an individual’s belief in their own capabilities as it corresponds with improvements in performance (Bandura, as cited in Bandura, 1997). Another technique that may be helpful is for individuals to disregard what goes on around them during an event and in so doing become aware of their own reactions to stressful events (Pennebaker & Lightner, as cited in Bandura, 1997). Individuals who are prone to panic may misread somatic states. Techniques that alter catastrophic thinking and provide them with concrete methods of controlling emotional arousal may serve to decrease negative biases in understanding physical sensations (Westling & Őst, as cited in Bandura, 1997).

An individual’s mood is often accompanied by fluctuations in quality of functioning. Mood also affects the interpretation of events, the manner in which it is cognitively organised, and ultimately retrieved from memory (Bower; Eich; Isen, as cited in Bandura, 1997). An associative network exists between mood and memory. When experiencing a specific mood this network activates corresponding memories. Therefore, thoughts of past failures are evoked when experiencing a negative mood while thoughts of past accomplishments accompany a positive mood (Bandura, 1997).

2.3.2.3 Achievement outcomes (behaviour)

The third influence in the triarchic reciprocal causality system is centred on notions of an individual’s behavioural capabilities and motivation as a factor that guides achievement outcomes. Woolfolk (2010) conceives of motivation as an internal state that arouses, guides, and sustains behaviour. A distinction is made between internal

and external sources of motivation. Intrinsic motivation is the pursuit of personal interests and activities that are satisfying and rewarding in its own right. Therefore, conquering challenges in pursuit hereof entails the exercise of individual capabilities without the need for incentives or punishments. By contrast, extrinsic motivation is founded on elements independent of the activity itself but rather what its pursuit will gain the individual. Reasons for doing something may be to earn a grade, please a teacher, avoid punishment, or any other reason that demonstrates minimal parallel with the task itself. As evident, the essential difference between intrinsic and extrinsic motivation resides in the individual's reason for acting, hence, whether the locus of causality for action (the location of the cause) is located inside or outside the individual. Interestingly, despite the distinction, most motivation contains elements of both. Although intrinsic and extrinsic motivations are distinct tendencies, they can function simultaneously during a specific situation (Woolfolk, 2010).

Social cognitive theories of motivation encompass both behavioural and cognitive approaches as it addresses concerns with the consequences of behaviour and the impact of individual beliefs and expectations. Accordingly, motivation is regarded as the product of an individual's expectation of attaining a specific goal and their valuing of the goal. The questions which guide motivation are: "If I try hard, can I succeed?" and "If I succeed, will the outcome be valuable or rewarding to me?" (Woolfolk, 2010, p. 379). This view corresponds with the perceived self-efficacy an individual has into their own capability of reaching a certain level of achievement (Bandura, 1986).

Within an academic setting motivation can potentially have a significant impact on the experience of mathematics anxiety and can thus be conceived of as an academic enabler (Linnenbrink & Pintrich, 2002; Hlalele, 2012). The motivational levels of learners who experience mathematics anxiety are significantly lower compared to their peers who report having minimal or no mathematics anxiety. In addition, a lack of confidence may result from mathematics anxiety and cause further decreases in motivation (Tapia; Zakaria & Nordin, as cited in Hlalele, 2012). This in turn means that these learners rarely display a desire to master mathematics as they perceive their skills in the subject as less than those in other subjects (Edelmuth; Kesici & Erdoğan, as cited in Hlalele, 2012). As is evident, motivation is significant in the experience of mathematics anxiety (Linnenbrink & Pintrich, 2002).

2.3.3 Cognition and test anxiety

The cognitive component of test anxiety has repeatedly been shown to have a significant impact on test performance (Cassady & Johnson, 2002; Morris et al., 1981). Hence, prior to embarking on a discussion of the intricacies of the cognitive component of test anxiety, it is necessary to gain a better understanding of the functioning of the brain with reference to anxiety.

Beck's (2011) cognitive model hypothesises that individuals' perceptions of events influence the emotions, behaviours and physiology they experience. There is thus interplay between the events, the thoughts that follow and ultimately the individuals' reactions in terms of emotions, behaviour and physiology. Learners' perceptions of an evaluative situation in mathematics may cause them to experience some anxiety (Cassady & Johnson, 2001). As a subjective state, anxiety can result in both adaptive and maladaptive responses to stress (Charney & Drevets, 2002; Etkin, 2009). In order to understand the neurobiology of anxiety, it is necessary to explore the biological contributions (Barlow & Durand, 2012) and neural circuitry which forms the core of individuals' normal responses to negative emotional stimuli and the regulation of its effects (Etkin, 2009).

Several authors (Clark, 2005; Eysenck, 1967; Gray & McNaughton, 1996) state that individuals inherit a tendency to be uptight, tense, and anxious. The tendency to panic also has a genetic component as it is deemed to run in families. The genetic contributions to anxiety and panic are however different (Barlow, 2002; Craske, 1999; Craske & Barlow, 2008; Kendler et al., 1995). No particular gene seems to cause either. Instead, various contributions from collections of genes in different chromosomes combine to form a genetic vulnerability to anxiety and panic. When these genetic components combine with the right psychological and social factors in the environment, it triggers an effect which may result in the experience of anxiety and/or panic (Gelernter & Stein, 2009; Kendler, 2006; Rutter, Moffitt & Caspi, 2006; Schumacher et al., 2005; Smoller, Block & Young, 2009).

The interaction between an individual's genes and their environment is encapsulated in the diathesis-stress model. Barlow and Durand (2012) explain that this model represents a specific method of interaction between genes and environment.

Diathesis refers to each inherited tendency that makes an individual susceptible to the development of a disorder or some form of distress. When a certain type of stressor occurs in the individual's life, the disorder or form of distress may develop. This diathesis or tendency needs to come into contact with certain environmental events in order for it to become prominent. Therefore, the diathesis is genetically based whereas the stress is environmental and upon interacting they may produce a disorder or some form of distress. As stated at the onset of this section, anxiety is also connected with specific brain circuits and neurotransmitter systems (Barlow & Durand, 2012); those pertinent to anxiety will now be explored.

The amygdala plays a central role as part of the neuro-anatomical circuits regulating emotions, including fear and anxiety. Situated adjacent to the hippocampus, the amygdala connects areas of the cortex responsible for processing higher cognitive information with lower metabolic responses as controlled by the hypothalamus and brainstem, as explained in the work of Charney and Drevets (2002). These anatomic systems are organised to permit responses to stimuli that are either rapid in nature or of longer latency. The former is usually in response to perceptions of potentially threatening stimuli while the latter results from more processed information concerning both multifaceted sensory stimuli and situational factors. Accordingly, the amygdala is involved in conditioning processes to explicit stimuli and the development of emotional reactions to environmental factors, thus coordinating physiological responses following on cognitive information (Charney & Drevets, 2002). Another part of the brain deemed important in the experience and management of anxiety, as reflected in its engagement with the Behavioural Inhibition System (BIS), is the hippocampus (Levita et al., 2014).

Anxiety may be conceived as encompassing three response domains: cognitive, behavioural, and physiological. These cause a state of worry characterised by negatively-biased cognitions, hyper arousal to threats and avoidance behaviours. Within this dynamic, BIS governs avoidance behaviours based on threat and punishment perceptions. In response to such perceptions, excessive activity in BIS could manifest as higher proneness to anxiety. Within the BIS, the amygdala and hippocampus mediate different components of anxiety. A study by Levita et al. (2014) found that a structural variation in the hippocampal formation may pose as a risk

factor for developing anxiety. Upon closer examination it was found that right hippocampal volume is related to behavioural inhibitions and may therefore be a mediating factor in BIS-related anxiety.

As this part of the discussion focused mainly on the behavioural component of anxiety, I wish to return attention to the cognitive component of test anxiety. The importance hereof was alluded to in the above discussion on the role of the amygdala reflected in the links between cognitive information and the cognitive component of test anxiety.

The negative impacts of the cognitive component of test anxiety are evident across a variety of student experiences (McKeachie, 1984; Naveh-Benjamin, McKeachie & Lin, 1987) and is not only limited to retrieval failure during the evaluation as postulated in self-reports of test-anxious learners (Mueller, 1980). This warrants further exploration into the cognitive component of test anxiety.

Research on the impact of test anxiety on information processing indicate that the latter can be compartmentalised into two categories: (a) cognitive interference during an evaluation, and (b) general cognitive processing skill deficiencies which hinder both test preparation and test performance (Naveh-Benjamin, 1991).

Cognitive interference has often been conceived as the cause of declined performance in the presence of test anxiety. Traditional conceptualisations proposed that irrelevant thoughts, worry and self-critical thinking creates a surplus of cues available to individuals during the evaluation, making it more difficult for them to focus on the task at hand (Sarason, 1986). Other theorists elaborated on this notion, stating that interference extends beyond the evaluative situation to include the preparation period. During the latter process interfering thoughts can obstruct understandings for content, resulting in failure on ensuing evaluations (Cassady & Johnson, 2002; Naveh-Benjamin et al., 1987).

Skills-deficiency explanations for the association between test anxiety and performance state that study skill is a prime determining factor for the manner in which performance is influenced by anxiety (Naveh-Benjamin et al., 1987). High levels of anxiety paired with poor study habits result in inferior views on subject

content when compared to similar levels of anxiety and good study skills (Naveh-Benjamin, 1991).

The work of Cassady (2004) elaborates on the aforementioned argument by postulating that cognitive test anxiety has a negative impact not only during test preparation and test performance but also after the evaluation when an individual reflects on the process. These three phases form the learning-testing cycle. The manners in which test anxiety relates to the learning-testing cycle will henceforth be discussed.

2.3.4 Test anxiety and the learning-testing cycle

Process-orientated conceptualisations of test anxiety incorporate elements of thoughts and patterns of behaviour across all the phases in the learning-testing cycle: test preparation (or forethought), test performance, and test reflection, thereby allowing for more detailed explanations of the phenomenon (Schutz & Davis, 2000; Zeidner, 1998). In accordance, an exploration of test anxiety and its relation to the different phases of the learning-testing cycle will ensue.

2.3.4.1 Test preparation phase

Test-anxious learners can be grouped into two categories: those able to adequately encode and organise information while preparing for an evaluation and those unable to do so (Birenbaum & Pinku, 1997; Naveh-Benjamin, 1991). Due to deficits in processing content, the latter group may experience performance failures (Everson, Smodlaka & Tobias, 1995). Ineffective study skills are a common feature of deficits in cognitive processing ability. The problem lies not in the amount of studying done as this is often equal to or more than that of low-anxious peers but rather in the methods employed which are often repetitive and less effective (Culler & Holahan, 1980; Wittmaier, 1972). As discussed earlier, this process is central to the skills-deficiency model of test anxiety. Deficits in cognitive processing ability are viewed as the main reasons for underperformance and the stimulus for experiencing test anxiety (Cassady, 2004).

Learners who are highly test anxious may display one of the following behaviours during the preparation phase: an overestimation of their level of preparedness or

consider their skills insufficient for successful performance, which resonates with a reduced sense of self-efficacy. Those individuals who fall into the first category may experience a false sense of security and thereby limit their preparation. In contrast, learners in the second category often experience a low sense of self-efficacy and may procrastinate or avoid preparation completely (Cassady & Johnson, 2002; Covington, 1992; McGregor & Elliot, 2002; Winne & Jamieson-Noel, 2002; Wolters, 2003). Learners in this category further often perceive tests as threatening occurrences. This is brought about by possible personal harm (related to low grades and low levels of self-esteem, as well as a lowered status) that may result from the evaluation, generalised low self-efficacy or difficult subject matter (Lay, Edwards, Parker & Endler, 1989; Schwarzer & Jerusalem, 1992; Bandalos, Yates & Thorndike-Christ, 1995; Schutz & Davis, 2000; Everson, Tobias, Hartman & Gourgey, 1993; Hong & Karstensson, 2002).

The above perceptions about evaluations can result in ineffective strategies of preparation driven by negative emotions such as helplessness and avoidance. This may lead to poor self-regulation during the actual test (Covington, as cited in Cassady, 2004; Elliot & McGregor, 1999; Schutz & Davis, 2000; Schutz, Davis & Schwanenflugel, 2002) which may lead to eventual failure (Cassady, 2004).

2.3.4.2 Test performance phase

The test performance phase encapsulates the time period during which the learner completes the test. Research indicates that during this phase learners with high-cognitive test anxiety report different experiences. Some report being knowledgeable on the test contents prior to the evaluation but upon entering the evaluation venue, the information somehow escapes them. This occurrence is termed “anxiety blockage phenomenon” and manifests when learners with high-test anxiety, who possess good study skills are presented with easy test items (Covington & Omelich, 1987). Conversely, learners with poor study skills experience reduced performance independent of testing format, difficulty or allocated time limits for completion. Others indicate that anxiety causes distractibility, interference, and inefficient cue-utilisation strategies (Cassady & Johnson, 2002; Sarason, 1986; Schwarzer & Jerusalem, 1992).

Retrieval failures result from debilitating contextual anxiety and incomplete conceptualisations of evaluative content. During the initial stages of the evaluation learners tend to form impressions about the difficulty level of the test. This is influenced by the actual difficulty of the content as well as their notion of readiness to take the test (Zeidner, 1998). Such judgements are impacted by self-deprecating thoughts, distracting emotional reactions which interfere with the task at hand, as well as task-irrelevant thinking (Sarason, 1986; Schutz & Davis, 2000).

2.3.4.3 Test reflection phase

The test reflection phase is concerned with future evaluation-related perceptions and behaviours based on learners' biased attributions. In societies where achievement and success are highly valued, and are directly correlated with future employment opportunities or social standing, learners' experience of failure may result in declining self-efficacy (Bandura, 1989; Cassady, 2004).

Upon internalising negative experiences of failure, learners may attribute failure to ability or lack thereof which in turn may deter consequent efforts to avoid failure and rather approach success (Elliot & McGregor, 1999). This may also result in the view that future tests are threatening as opposed to challenging events (Schwarzer & Jerusalem, 1992). Such perceptions signify a shift away from the motivational "Challenge Stage" where attributions for failure are internally based to one where perceived threat and anxiety are both rife and debilitating. This is indicative of a "Loss of Control" perspective where the locus of control is externalised and learners feel helpless and disengaged from academic tasks, resulting in failure (Schwarzer & Jerusalem, as cited in Cassady, 2004, p. 574).

The transition from the reflection phase to the following test's preparation phase is not clearly marked by separation lines. As a result, the longer learners remain concerned with the negative feelings produced by their attributions, the more difficult it is for them to successfully prepare for future evaluations (Covington, as cited in Cassady, 2004).

2.4 SUMMARY OF CHAPTER

The aim of this chapter was to provide an overview of literature on test anxiety pertaining to mathematics. This was done by postulating social cognitive theory as the central theory to the study and incorporating supporting theories in order to synthesise a conceptual framework for exploring the phenomenon under inquiry. By using a social cognitive lens for this study, a detailed explanation of human thought, motivation and action in relation to anxiety surrounding mathematics evaluations could be provided. The intention was to contextualise the study and reveal the “niche to be occupied” by it through the literature review (Henning et al., as cited in Oswald, 2010, p. 28). The process of this research, as prescribed by the research plan, will be discussed in the following chapter.

CHAPTER 3

THE PROCESS OF INQUIRY

3.1 INTRODUCTION

In this chapter focus is placed on the research paradigm which is comprised of philosophical assumptions that guide thinking and action thereby informing all methodological decisions regarding data collection, observation and interpretation (Mertens, 2005). In an attempt at addressing 5the concept of a research paradigm, I will position my research in axiological, ontological, epistemological, and methodological terms as these aspects constitute the philosophical assumptions to which earlier reference was made.

Central to the study is the intent to describe the subjective reasons and meanings of adolescents' test anxiety in the subject of mathematics so as to gain a better understanding of the phenomenon. Throughout the discussion it will be made evident why an interpretive paradigm with qualitative methodology is found to be the most fitting methodological approach for this inquiry.

3.2 RESEARCH PARADIGM

3.2.1 Interpretive paradigm

A paradigm, according to Mertens (2005), constitutes a way of looking at the world which in turn guides thinking and action, especially in research. Blaikie (2000) states that individuals produce and reproduce understandings of the social world through the activities they engage in on a continuous basis. The meanings and interpretations awarded to actions, social situations, and objects manifest as everyday reality. This encapsulates an interpretive paradigm wherein individuals and their perceptions, interpretations, understandings and meanings are deemed the primary data sources. In this manner insight into the phenomenon under inquiry can be gained from an insider perspective as experienced by the participants (Mason, 2002).

An interpretive paradigm further encompasses a set of beliefs held by a person that define the nature of the world, the individual's position within it, and the accompanying relationship with or within the world for the particular holder (Hills & Mullet, 2000). The aforementioned translate into the aspects which define a paradigm, namely beliefs about ontology, epistemology and methodology. Denzin and Lincoln (2005) elaborate on this notion by adding that axiology, which is concerned with ethics or values, form the guiding principle in any research undertaking. These authors then speak of a paradigm as encompassing four as opposed to only three beliefs. Mertens, Holmes and Harris (2009) support this view and refer to axiology as the first of the four basic beliefs. Central to each belief is a question which assists in defining a particular paradigm (Lincoln & Guba, 2000).

3.2.2 Basic beliefs act as guiding principles

Axiology is the branch of philosophy that studies values (Babor, 2006). Guba and Lincoln (2005) provide a rich description of the role values embody in research. According to them, values impact on the choices concerning the problem under inquiry, the research paradigm to guide the exploration process, the theoretical framework utilised, the methods of data-gathering and data-analysis, and ultimately the manner in which the findings are presented. The axiological beliefs of my study will reflect an attempt at addressing the central axiological question, "How will I be as a moral person in the world?" (Denzin & Lincoln, 2005, p. 183). It will do so by indicating how I, the researcher, engage with this research process in an ethical manner. This discussion will be presented in dual form. Firstly, it will be implicit in the ideas, notions and approaches throughout this chapter. Secondly, a more explicit discussion hereof is presented in the section *Ethical Considerations*.

Ontology is focused on the nature of being and existence. As it is concerned with the nature of social reality and assumptions about human existence (Holloway, 1997), it asks the question "What is the nature of reality?" (Mertens, 2005, p. 8). Within an interpretive paradigm, reality is viewed as socially constructed based on the premise that the mind is active in the construction of knowledge. Individuals do not discover knowledge by chance but rather construct it through an active process of interactions with their environment. Consequently, various mental constructions and perceptions of reality can exist and also change over time. These constructions and perceptions

may even be in conflict with each other. Based on this view, I reject the notion that there is an objective reality that can be known. My goal is rather to understand the various social constructions of meaning and knowledge individuals make surrounding anxiety and mathematic evaluations (Mertens, 1998; Schwandt, 1994).

Epistemology poses the question, “What is the nature of knowledge and the relationship between the knower and the would-be known?” (Mertens, 2005, p. 8). Hence, epistemology describes the theory of knowledge (Holloway, 1997). In accordance, epistemological considerations are dependent on beliefs held about the nature of knowledge. This includes forms of knowledge, communication of knowledge, access to knowledge, and knowledge acquisition. All these aspects influence the research process (Hitchcock & Hughes, 1995). As the researcher, I need to be cognisant of the manners in which these processes influence the research process. This entails recognising that in relation to the basic principles guiding the interpretive paradigm I acknowledge that the data generated during this study is in part a reflection of the knowledge constructed during the active interactions stemming from the data collection process. Nevertheless, my aim remains to explore the understandings and meanings that the participants attribute to anxiety pertaining to mathematics as experienced by each individual (Mertens, 1998; Schwandt, 1994).

Holloway (1997, p. 105) postulates, “Methodology is more than method.” The latter is concerned only with the procedures and techniques employed by the researcher while the former refers to the principles on which researchers base their procedures and strategies. It also includes the assumptions held about the nature of the research, as well as the ideas that underpin data collection and analysis. The methodological question is thus, “How can the knower go about obtaining the desired knowledge and understandings?” (Mertens, 2005, p. 8). From an interpretive vantage point research can only be conducted through interaction between me, the researcher, and the participants (Guba & Lincoln, 1994). This interactive approach is described as hermeneutical and dialectical as attempts are made to gain insight into various perspectives that produce intricate interpretations of meanings (hermeneutics) that are compared through a dialectical interchange that involves the “juxtaposition of conflicting ideas, forcing reconsideration of previous positions”

(Guba & Lincoln, 1989, p. 90). This process will assist me in knowing what meanings individuals attribute to activities pertaining to evaluations in mathematics and how these in turn relate to their behaviour. In accordance, I am part of participants' construction of reality based on the data they provide and the interpretations that flow forth from the data collection process (Mertens, 1998).

3.2.3 Qualitative methodology

Qualitative research allows the researcher to "engage with things that matter, in ways that matter," as Mason (2002, p. 1) so fittingly states. This approach to research allows one to explore a myriad of dimensions of the social world, in this particular case, the phenomenon of test anxiety as it pertains to evaluations in mathematics. It allows for insight to be gained into the texture of everyday life, the experiences of research participants, as well as the manner in which social discourses work and the implication of the meanings they produce. Mason (2002, p. 3) further postulates that a philosophical position interested in the manner in which the social world is "interpreted, understood, experienced, produced or constituted" lends to qualitative research its broad positioning within an interpretivist view. This enables the researcher to gain insight into the multi-layered and textured social world of the participants. Data generated within a social context is often nuanced, detailed and rich as methods of its gathering take cognisance of the complexity, detail and context from which data is gained. Such a flexible yet sensitive approach to data collection is most fitting to an exploration of the meaning of a specific phenomenon, like mathematics test anxiety (Mason, 2002).

As qualitative research methods allow for in depth exploration of phenomena it has been deemed the most appropriate approach to this study (Patton, 2002). The study is based on the assumption that the anxiety individuals experience form part of their subjective world. Accordingly, the study is positioned within an interpretive paradigm as it allows for the understanding of the nature of the participants' experiences (Silverman, 2010).

3.3 RESEARCH DESIGN

A research design resembles a strategy for obtaining knowledge or simply put, finding out something. Two major aspects are involved in the research design of a study. Firstly, I as the researcher, need to specify in a clear and precise manner what I want to find out. Secondly, I must determine the way best suited to go about doing so. It becomes evident that the research design of my study will address the planning of the inquiry (Babbie & Mouton, 2001).

This social research inquiry is oriented toward exploring human experience from the viewpoint of the individuals themselves, thereby gaining an insider perspective into the phenomenon being explored, namely mathematics test anxiety. A basic qualitative research design (Merriam, 1998) applying thematic analysis (Braun & Clarke, 2006) will be employed during the research process.

3.4 METHODS

3.4.1 Selection of participants

In an attempt to find an information-rich setting wherein test anxiety pertaining to mathematics is most likely to occur, purposive sampling was utilised to select a high school in the Western Cape. This sampling method enables the qualitative researcher to pinpoint a setting and individuals wherein the process being studied is most likely to occur (Merriam, 2009; Silverman, 2010). An information-rich setting acts as a resource from which a great deal can be learnt about aspects pertaining to the purpose of the study. When such a setting is paired with the aforementioned sampling method, it has the potential to yield insights and in-depth understanding of particular individuals' experiences within their specific context (Patton, 2002).

Participants in the study are the primary data sources; these include both learners who elected mathematics as subject and their mathematics teacher. Secondary hereto are participants' mathematics test and exam results, as well as a creative method constituting drawing of the feelings prior to a mathematics test. The intent is to gather useful and meaningful information about empirical contexts from which data and ideas can be generated that will advance the researcher's understandings of the

phenomenon under inquiry thus producing the opportunity for the formation of an empirically and theoretically founded argument (Mason, 2002).

The sampling process necessitates both theoretical and empirical considerations regarding the researcher's views on the nature and significance of the broader population from which the particular sample is drawn (Mason, 2002). As this study employs purposive sampling, it requires the researcher to use her knowledge or expertise about a group from which participants are selected as representative of the population (Berg, 2009). Accordingly, I consulted with the head of the mathematics department at the school. Together we combined our knowledge on the subject matter, occurrences of anxiety related behaviour and possible factors which contribute to manifestations of the latter. Based on our shared knowledge we selected learners from the grade 10 group doing mathematics to approach and enquire whether they would volunteer to participate in the study. As anxiety pertaining to mathematics as experienced by grade 10 learners is the focus of this study, the nine participating individuals form the unit of analysis (Babbie, 2010).

3.4.2 Data collection

Kvale proposes (1996, p. 1), "if you want to understand how people understand their world, their life, why not talk with them?" As my research focuses on grade 10 learners' experience and understanding of mathematics test anxiety, it seemed logical to access these experiences and understandings by engaging learners in conversation.

Essentially, data collection is geared toward expanding existing knowledge and understandings about the social world. In-depth interviewing is a channel through which information about social worlds may be gained by exploring the individual meanings awarded to experiences (Silverman, 2004). In an effort to ensure that the information shared by participants is truly oriented toward the insider's perspective, the language used during the interview should be adjusted to match that used by each interviewee during the interview process. Doing so will enable the intent of this inquiry, which is to obtain results that are rich and textured in its description of learners' experiences and understandings of mathematics test anxiety, to materialise (Berg, 2009).

Within a qualitative methodology, “the interactional exchange of dialogue” can take on different forms (Mason, 2002, p. 62). This study utilised one-on-one interactions between the researcher and participants in the form of semi-structured interviews, as well as larger group interviews. The latter, however, was not an interview in the true sense of the word. Rather, it refers to the dialogue between the researcher and the group of participants while engaging in a creative exercise entailing the drawing of the feelings prior to an evaluation in mathematics. The semi-structured interviewing process used within qualitative methodology has certain core features. Those applicable to the current inquiry will henceforth be discussed.

The dialogue between researcher and interviewee is a conversation as it distances itself from a formal question and response structure and assumes a stance of thematic exploration. The researcher explored various preconceived themes intended to be utilised for exploration of the phenomenon mathematics test anxiety, done in a fluid and flexible manner. This also produced the space in which unexpected themes may be created between the researcher and the interviewee as the dialogue takes place.

Qualitative inquiry assumes that knowledge is both situated and contextual. Therefore, within this interactive space meanings and understandings are constructed or re-constructed between the parties concerned by concentrating on the relevant contexts from which situated knowledge may be produced. These factors give the interviewing process an informal style (Mason, 2002). This speaks to the nature of knowledge as well as the relationship between me, the inquirer, and the participants or the would-be known as encapsulated by the epistemological belief underlying this inquiry.

Furthermore, this style of interviewing necessitates that the researcher has been able to navigate through the discussion in an effective and coherent manner that was consistent with the research questions (Mason, 2002). Whilst collecting the data I aimed to address this by being well acquainted with the themes I wanted to explore during the interviews. In addition, I also tried to keep the research questions firmly entrenched with intellectual and technical orientations during the interview process. This meant that I relied on voice notes and concise note taking to supplement my thinking but because I was familiar with the themes I wanted to explore, I was able to

make many decisions and judgements quickly, without always referring to my technical systems. This in turn enabled me to follow the interviewee's trail of thought whilst ensuring that the most essential components of the interview were incorporated into the conversation.

Overall, a researcher should be attuned to the intellectual and social dynamics of the interview context so as to ensure that both relevant and valuable data is generated (Mason, 2002).

3.4.3 Data analysis

The qualitative analytical method employed for this study is thematic analysis. This method is an accessible and theoretically flexible research tool with the potential to yield a rich, detailed and complex account of data. As thematic analysis is characteristically flexible, it may be critiqued for lacking pertinent guidelines. In an effort to address such possible critique, the researcher employing this method should provide a clear demarcation thereof by making active choices about the specific form of analysis utilised (Braun & Clarke, 2006). Holloway and Todres (2003) add that the researcher's philosophical beliefs should be made explicit as another precaution to possible critique. As a shield against the second notion of possible critique, the beliefs underlying this study were made clear in a previous section entitled *Basic Beliefs Act as Guiding Principles*. Furthermore, a detailed account of the intricacies of the employed methods will be provided in the following section, thereby acting as a precautionary measure against the first notion of possible critique.

Thematic analysis, utilised within this study as a data analytic strategy, is a method that allows for the identification, analysis and reporting of patterns, also termed themes, within data. The method also describes the data set in detail and may interpret different features of the topic under inquiry (Boyatzis, as cited in Braun & Clarke, 2006). Within this process, the researcher plays an active role in identifying themes across an entire data set as opposed to focusing solely on one data item, selecting from these themes those which are of interest, and ultimately reporting these to the readers (Taylor & Ussher, 2001). The active role of the researcher highlights the fact that their thinking and conceptualisation of the data influences the connections made during the analytical process as a reflection of the researcher's

understandings of the content (Ely, Downing & Anzul, as cited in Braun & Clarke, 2006).

The act of doing thematic analysis can be divided into six phases. Firstly, the researcher needs to familiarise themselves with the data that has been collected. This involves the transcription, reading and re-reading of the data while making notes on initial ideas. Secondly, the researcher works through the entire data set in a systematic manner whilst coding intriguing aspects of the data. Next the researcher collates data that relates to each code. Thirdly, the search for themes commences. The codes identified in the previous phase are now sorted into potential themes and so are all data relevant to these themes. This means that the researcher is analysing codes in order to consider how these may combine to form an overarching theme. Fourthly, the researcher reviews the themes in order to determine how these relate to both the coded extracts and the entire data set. Fifthly, the researcher continuously analyses the data in order to refine each theme and creates clear definitions and names for each identified theme. Lastly, the researcher selects and analyses fascinating extract examples; then relate the analysis back to the initial research question and literature. Thereafter a scholarly report is produced of the analysis (Braun & Clarke, 2006). These six phases are thus reflective of the procedures I aimed to follow during the process of data analysis. In addition, data verification methods that were employed will also be explained.

3.4.4 Data verification

Member validation, also termed member checking, will form an integral part of the data analysis process. This strategy stipulates that the data obtained from the participants, as documented by the researcher, be presented to them. The researcher thus shares with participants the findings by focusing on pertinent facts and narrative statements, not the interpretations hereof. Interpretations are addressed in a different manner. The researcher may choose to report the findings and ask participants how they would interpret it or the researcher will interpret the findings beforehand and present it to the participants but allow them the opportunity to voice their opinions on the accuracy thereof and then enter into discussion around this. Member validation thus provides valuable insights into understandings of the phenomenon under inquiry as it offers the opportunity for participants to verify data

and check the interpretation and presentation thereof (Crilly, Clarkson & Blackwell, 2006; Lincoln & Guba, 1985; Sagor, 2005). King and Horrocks (2010, p. 163) term this process “respondent feedback” as it provides participants with a strong voice in how they are presented. They further emphasise the fact that this addresses issues of both quality and ethics. Member validation thus serves as a means of ensuring methodological rigour.

Rigour in method can also be achieved through the process of triangulation – the use of different methods for the generation of data. It also constitutes a strategy to endorse the quality of qualitative research and relates to validity (Flick, 2009).

I employed the aforementioned data verification methods during the research process. Mertens (2005) postulates that member checking can be done in either a formal or informal manner. I opted for the latter and at intervals during the interview as well as at the end of the session, summarised what had been said and asked whether the interviewee’s position is accurately reflected herein.

In addition, I employed different data collection methods. At the onset I intended to conduct individual semi-structured interviews with both participants and their mathematics teacher, consult the learner-participants’ test and exam results as obtained over a period of two years dating back to grade 8, and do a creative group exercise entailing the drawing of the feelings prior to an evaluation in mathematics. In practical terms, the individual semi-structured interviews were conducted as intended. Hereafter, the group of learners partook in a creative exercise during which they drew visual representations of their feelings before an evaluation in mathematics. Obtaining learners’ academic records posed challenges. Most learner-participants indicated that they either do not keep copies of all their evaluations or that the teacher keeps it. Therefore, they were unable to provide me with full records of their mathematics results. In a consequent effort to obtain their mathematics results, I consulted with the school secretary as I deemed it likely that she may have their results on a central database. However, she was unable to assist me and referred me to the head of the mathematics department. The mathematics teacher verbally agreed to collect all the relevant information from the mathematics department’s central database. In due course, she provided me with the final mathematics mark of each learner-participant as obtained at the end of grades 8 and

9, as well as their mid-year grade 10 results. As is evident, although no test results were obtained, I was able to collect learners' final exam marks in mathematics for a two and a half year period. Accordingly, what I report on pertains to information obtained during the interviews with learners and the mathematics teacher, learners' academic records, as well as the creative drawing exercise. The latter is not discussed as a separate section but rather, the themes which transpired from it, is intertwined with the themes contained in the interview data. The rationale hereof is to provide a cohesive and nuance representation of the data.

3.5 RESEARCH PROCESS

During the course of this chapter I make reference to particular details of the research process as it pertains to the topic under discussion. Therefore, my intent is to provide an overview of the research process in this section. It follows that I may make reference to points already discussed but for the sake of being thorough I shall now describe the research process as a whole.

At the onset, upon obtaining ethical clearance from the Western Cape Education Department (see Addendum B), I approached the principals of various high schools in the Western Cape. I introduced them to my study and its underlying ideas. I then requested to conduct my research within their school. The initial school that granted me permission to collect data from their group of grade 10 mathematics learners withdrew before the data collection process commenced. I was then forced to broaden the radius of schools within my immediate geographical location and again approach several principals.

Eventually, I came in contact with the head of the mathematics department at a Western Cape high school who was willing to assist me in this endeavour. Although the teacher was willing, I still needed the principal of the school's permission to conduct my research within this academic setting. Obtaining the principal's signature as an indication of permission granted to enter his school context and engage with the learners, was a lengthy process. This was mainly due to the fact that the principal had on a previous occasion allowed another student to make use of his school as a research setting and said process resulted in negative consequences for the school community. Accordingly, I had to prove the sincerity of my objectives, share the most

intricate details of my research to the degree to which I was able to predict at the time, and assure the principal of the mutual advantage to both the school and me if they are to become part of my study. Hereafter, I was granted written consent (see Addendum C) to conduct my study at the school.

Furthermore, I applied to the Research Ethics Committee of Stellenbosch University to conduct my research in the manner described in this thesis. Upon meeting all the ethical requirements of the committee, said permission was granted (see Addendum A).

Once permission from both parties had been granted, I liaised with the head of the mathematics department at the school to arrange meeting times. Firstly, we discussed the basis on which participants were to be selected. Hereafter, I approached the chosen group of learners, introduced them to the study and asked who would volunteer to participate. To my delight, the entire group volunteered. Following an explanation of their right to withdraw from the study at any point, I obtained each learner's written consent (see Addendum D). I also gave them each a consent form to have signed by a parent and requested that they return the parental consent form (see Addendum E) and submit it to the head of the mathematics department from whom I would then collect all forms.

The next step was to begin the data collection process. The school allowed me to interview learners on days when the entire school was scheduled to write tests. Practically, this meant that the first hour of certain days was dedicated to writing tests in specific subjects. On those days I would visit the school and interview those in my group of volunteers who, due to their particular subject choice, were not writing on that specific day. Over the course of four days I was able to conduct individual interviews with all the learner participants. Hereafter, I visited the school on another occasion with the intent to do the creative drawing exercise. On this specific day only seven of the nine learners I had previously interviewed were available to partake in the exercise. As such, we got together in the same venue as the one where all the interviews were conducted. I again explained the nature of the exercise and presented the group with materials such as cardboard, coloured pens, pencils and ribbons to use for the exercise. Whilst depicting their feelings prior to an evaluation in

mathematics (see Addendum J) we engaged in conversation concerning what exactly they feel and experience, as well as their chosen visual depictions hereof.

Upon concluding my engagement with the learner-participants, I arranged, after obtaining her consent (see Addendum F), to interview the mathematics teacher who is also the head of the mathematics department at the school. She was able to accommodate me on a day when the entire school was writing the Western Cape Education Department's Annual National Assessment. In her office we engaged in conversation pertaining to the phenomenon under inquiry.

During both the interviews with the learners and their mathematics teacher, I used the interview schedules (see Addenda G and H) I had drafted prior to commencing the interview process. I also allowed space for each interviewee to share information they felt were applicable even if not included in my interview schedule. As the interview with the mathematics teacher occurred after the interviews with the learners, I was able to use the information the learners shared to include in my interview with the teacher so as to gain a richer, more personalised depiction of the phenomenon of test anxiety concerning mathematics as it occurs within this specific context.

The interviews were transcribed (see Addendum I) and analysis (see Addendum K) hereof followed. Furthermore, I used the recording of the conversation that took place when the group conducted the creative exercise to identify prominent themes and to see how these relate to the information shared during the individual interviews.

3.6 THE QUALITY OF THE RESEARCH

Principles of validity and reliability are central to the credibility of a study (Borgia & Schuler; Dick; Lather; Weiner; Winter, as cited in Adendorff, 2007). In selecting a qualitative research design a particular view of the world is presupposed that in turn defines how a researcher approaches issues of validity and reliability (Merriam, 2009). The researcher's guarantee that the data reflects the phenomenon it claims to, ensures the validity of the study, whereas reliability is portrayed in the accuracy of data collected (Sagor, 2005).

Reflexivity is another principle that speaks to the credibility of a study. King and Horrocks (2010, p. 125) describe reflexivity as a complex endeavour entailing "reflection and thoughtfulness". Guba and Lincoln (2005, p. 210) support this view by postulating that "reflexivity is the process of reflecting critically on the self as researcher, the human instrument". Reflexivity further impacts on the theoretical understandings that underpin research and the practicalities of the research process. It constitutes both inward and outward explorations of the relationship between existing knowledge, experiences, our roles as researchers and the world around us. Delmont (as cited in Walker, 1998, p. 250) encapsulates the aforementioned in the following summary:

> Each researcher is her own best data collection instrument, as long as she is constantly self-conscious about her role, her interactions, and her theoretical and empirical material as it accumulates. As long as qualitative researchers are reflexive, making all their processes explicit, then issues of reliability and validity are served.

In an attempt at being both transparent in my personal views and values, and the manners in which these impact on the research process, I have aimed to explicitly state my personal perspectives with supporting reasons for my decisions made. This also aims to simultaneously increase the reliability and validity of the study.

3.7 ETHICAL CONSIDERATIONS

Conducting research at Stellenbosch University necessitates that one adheres to the institution's research policy that stipulates all research involving direct interaction with human participants or the capturing of any personal information go through a process of ethical clearance (Stellenbosch University, 2013). In accordance, it was necessary for me to obtain ethical clearance prior to commencing the research inquiry. This process of obtaining ethical clearance entailed me discussing how I would adhere to certain ethical guidelines in my research practice, as stipulated by the Research Ethics Committee.

Ethical guidelines acted as a yardstick to measure the integrity with which the study is carried out. Therefore, I have chosen to include a short discussion on how I have

attempted to adhere to such guidelines whilst conducting my research. The steps described below were taken to ensure that the basic ethical principles of non-maleficence, beneficence, autonomy and respect, and justice were honoured, as far as possible (Flick, 2009; Wassenaar, 2006). As the methods of ensuring these principles were discussed in chapter 1 under the section *Ethical Considerations*, what I list here serve as a synopsis of the process on ensuring ethical integrity.

Allan (2011, p. 128) conceives of autonomy as "people's right to freely and voluntarily make informed decisions pertaining to their lives". Informed consent involves informing participants about the aim of the study, as well as of the possible risks they may encounter and benefits they might gain (Kvale, 1996). In an effort to ensure that the consent granted by participants were as informed as possible, I disclosed to them what the research would entail, in as far as I could predict. I also stated that the interviews will be audiotaped in order to be transcribed at a later time. Furthermore, I informed them that they may refuse to participate, or withdraw from the study even after having volunteered, without encountering any negative consequence to themselves. In so doing, I attempted to minimise any possible coercion that may stem from the perceived nature of the power dynamic between the participants and me. Of the nine learners and one teacher who volunteered to participate, none withdrew from the study. The aforementioned actions served to address the principle of non-maleficence, as well as elements of the principle of autonomy and respect.

Wassenaar (2006, p. 67) states that the principle of autonomy and respect for dignity are "operational expressions" of the principles of confidentiality and anonymity. These principles were ensured as all transcriptions of the interviews were stored in a password protected computer and numbers, as opposed to real names, were used to identify participants. Furthermore, all identifying details of the individual participants, the school and broader community were altered in the presentation of this thesis, and will be similarly altered in any other distribution of the research results.

In order to further respect the autonomy and dignity of participants, the research was viewed as a collaborative effort. As such, all participants and I worked collaboratively towards the construction of knowledge pertaining to learners' experiences and understandings of the research phenomenon. This was achieved by granting participants the opportunity to engage with the information they shared by presenting

it back to them in summarised form throughout the interview process. In addition, learner-participants were able to actively engage with each other's knowledge during the creative drawing group exercise. This provided the platform for discussion and the exchange of information that may be beneficial to fellow participants. Lastly, we made joint decisions regarding what would be documented in the thesis or any other distribution which may flow forth from this research. These actions are in accordance with the work of Winter (1996). It follows that in addition to addressing the aforementioned ethical principles, these actions also attend to issues of beneficence and justice.

This collaborative process further served as a safeguard against the reproduction of the perceived nature of the power dynamic between the participants and me, as the researcher. Within this process I attempted to exercise reflexivity as a method of being sensitive and responsive to the dynamics that manifest in the relationship between the participants and me. Through working collaboratively with participants, I steered away from speaking on behalf of the 'other' and rather attempted to make the research process and its outcomes co-owned by me and the participants (Denzin & Lincoln, 2005). These actions demonstrate attempts to adhere to the principles of non-maleficence and justice.

My discussion on ethics and the guiding axiological principles of the study were strongly influenced by an understanding that "the search for new knowledge relates to living in ways that will be to the good of all, and will not only benefit some at the expense of others" (Kotzé, 2002, p. 26). I acknowledge that my efforts to adhere to these principles may be ideological but I am of the opinion that it is only through such conscious efforts that I may position myself as a moral person in the world.

3.8 SUMMARY OF CHAPTER

This chapter addressed the research process of the inquiry. In doing so, detailed descriptions of the research paradigm, research design and methods were given. The underlying beliefs which influence every aspect of the research process were also put forth. In addition, the actual research process was depicted in an effort to provide the reader with a vivid description of the events surrounding the execution of the research idea. Specific reference was also made to criteria for judging the quality

of the research. Hereafter, the chapter concluded with a discussion on the ethical considerations that underpinned the entire inquiry. The next chapter discusses the research findings that emerged from the research process as described in this chapter.

CHAPTER 4

RESEARCH FINDINGS AND DISCUSSION

4.1 INTRODUCTION

As discussed in chapter 1, the primary research question this study aimed to address, was:

> How do grade 10 learners experience and understand mathematics test anxiety?

The sub-questions which were formulated were:

> What factors might contribute to the experience of anxiety related to evaluations in mathematics?
>
> When does anxiety not influence evaluations in mathematics?

An exposition of the research findings is presented in this chapter in an effort to provide answers to the above research questions. In order to present the findings in a meaningful and concise manner, it was necessary for me to group the data into themes and categories during data analysis. The themes and categories that naturally arose from the data serve as representation of the voice of participants.

After presenting the most prominent themes that emerged from the data, the sections that follow will be dedicated to the discussion of the findings in relation to existing literature. Table 4.1 provides a summary of the themes and categories which emerged during data analysis.

Table 4.1: Themes and categories

Themes	Categories
Emotionality and worry components of mathematics test anxiety	- Affect - Personality trait - Physiological effects - Cognitive effects - Motivation
Influences on the experience of mathematics test anxiety	- Downhill trend - Reasons to worry - Expectations and pressure - Others' perceptions - Others' influence - Comparisons with others - The importance of mathematics - Mathematical challenges - Mathematics learners' needs
Resources	- Coping mechanisms - Seeking assistance - Guidance provided - Study methods
Achievement	(Discussed as a complete theme)

4.2 RESEARCH FINDINGS

The research findings will be presented in accordance with the themes and categories grouping outlined in Table 4.1. I have used these themes to portray, as far as they have communicated it with me, the experiences and understandings of the learners and mathematics teacher who participated in the study. The narratives contained in this chapter were extracted from the data generated during the data collection process which consisted of ten individual semi-structured interviews, of which nine were with learners (coded as L1, L2, L3, L4, L5, L6, L7, L8 and L9) and one with the mathematics teacher (coded as T). The discussions presented here are further informed by the creative drawing of the feelings group exercise which was

done with seven of the nine learner-participants, as well as information obtained regarding past exam results in mathematics dating back to grade 8. It is evident that the participants were the primary data sources allowing for insight to be gained into the phenomenon under inquiry from an insider perspective, thus adhering to the interpretive paradigm of the study (Mason, 2002). As the researcher, my understanding of the themes used will add complementary nuances to the discussion.

4.2.1 Emotionality and worry components of mathematics test anxiety

4.2.1.1 Affect

This section explores the emotional experiences of learners as it pertains to general life events and mathematics in particular. Furthermore, it describes the manifestations of such affect in learners, which the mathematics teacher has witnessed in class situations.

At the onset of this study it was stated that all individuals experience some degree of anxiety (Huberty, 2009). The experiences shared by learners during the data collection process confirmed this notion. Learners used terms such as worry (L1, L2, L3, L5, L7, and L9) and stress (L3, L5) to portray general feelings of concern about particular life events. When focusing solely on emotions surrounding mathematics, learners revealed various individual experiences. These experiences will be portrayed as it relates to the learning-testing cycle's test preparation, test performance and test reflection phases (Schutz & Davis, 2000; Zeidner, 1998).

Anxiety and stress are common emotions prior to an evaluation in mathematics (L2, L6, and L7). For many learners this phase is accompanied by fleeting thoughts of everything they need to know which in turn may present as fear of forgetting something important, as was most aptly described by the following participant: *"… alles gaan net so deur my kop wat ek moet ken en ek is bang ek vergeet iets belangriks …" […everything I need to know goes through my mind and I am scared of forgetting something important …]* (L1). Furthermore, learners who are familiar with the work have a sense of calmness about them at this stage *("… as ek weet ek ken my werk dan bekommer ek nie myself nie.") […when I am certain that I know my work, I do not worry.]* (L3). Similarly, learners who tend not to worry about schoolwork

too much experience minor levels of stress prior to a test *("… as ek nou kom by die punt waar dit nou net voor die toets is dan stres ek glad nie, want ek weet ek het klaar alles ingesit …" [I do not stress shortly before the test because I know I have already put in everything.]* (L2), whereas exam situations generally evoke more anxiety *("… stres nie meer vir 'n toets nie, behalwe vir die eksamens, dan is dit bietjie, ek weet nie wat om te verwag in die eksamen nie.") [I do not stress about a test anymore, except for exams. I do not know what to expect in an exam.]* (L8). By contrast, learners who regard their preparation as having been insufficient, experience some degree of distress, as shared by Learner 6: *"Ek voel half angstig as ek weet ek het nie heeltemal soos goed genoeg of hard genoeg geleer nie." [I feel somewhat anxious if I know I did not study hard enough.]* (L6).

The majority of learners indicated that they are calm and focused during the actual evaluation period, as evident in: *"… ek dink nie aan iets anders nie en ek fokus net op wat ek nou moet doen." [… I do not think of anything else and I focus only on what I need to do at present.]* (L7); and *"Ek is so kalm soos kan kom ... Ek stres nie rêrig vir wiskunde nie." [I am as calm as can be ... I do not really stress about mathematics.]* (L2). Preparation appears to be a contributing factor to this sense of calm, as is reflected in the following: *"As ek geleer het voel ek heel rustig." [If I studied, I feel calm.]* (L4). It also helps if the first item on a test is easy to solve as this creates a positive feeling about the test and acts as encouragement to continue to tackle the rest of the items on the test *("… as ek soos die toets voor my kry en ek kyk, soos die eerste vraag en ek sien dit is heel maklik, ek kan dit doen dan raak, maak ek myself rustiger." [... if I have the test in front of me and I see the first question is easy, I am able to do it, then I become calm.]* (L9). The teacher attests to the latter notion by postulating that the first calculation on a test should be easy to solve (T).

While most learners reported being able to remain calm and focused during the evaluation phase some find that their mind tends to wander to content outside the realm of mathematics as opposed to remaining focused on the test. This occurrence is illustrated by the following quote: *"… ek konsentreer nie altyd as ek wiskunde skryf nie … ek kan nie altyd baie goed konsentreer op die toets nie, so ek dink aan baie*

goed …" [I do not always concentrate when I am writing mathematics. I cannot always concentrate on the test so I think of many things …] (L6).

After evaluations in mathematics learners experience a range of emotions. Evidence of each of these emotional experiences, as portrayed in the words of participants, is reflected in the following discussion.

Learners most commonly reported feeling relieved that the test is over, as is revealed in the following: *"Dan is ek só verlig. Dit is soos 'n berg van my skouers af." [Then I am so relieved. It is as if a mountain has been lifted off of my shoulders.]* (L7); and *"Ek voel verlig, soos ek kan weer aangaan." [I feel relieved, as if I can go on again.]* (L6). Another post-evaluation experience is a sense of calmness if learners felt positive whilst writing the test or exam, as is evident in: *"As ek lekker geskryf het dan is ek baie rustig …" [If I wrote well then I am very calm.]* (L2); and *"As ek lekker geskryf het dan voel ek lekker en rustig daaroor …" [If I wrote well then I feel nice and calm about it …]* (L3).

Stress, particularly if learners' preparation is considered to have been insufficient or they wrote a bad paper and anticipate poor marks is another frequently described emotion following an evaluation in mathematics. Notions hereof are conveyed in the following statements made by learners: *"Dan is ek redelik kwaad vir myself, want ek weet ek kon beter gedoen het as ek net soos 'n halfuur bietjie langer geleer het." [Then I am fairly cross with myself because I know I could have done better had I studied half an hour longer.]* (L8); *"… as dit nou nie die beste toets was nie sal ek…stres oor my punte …" [… if it was not the best test then I would…stress about my marks ...]* (L2); *"… na die tyd stres jy, want jy weet nie of dit reg is nie." [… afterward you feel stressed because you do not know if it is right.]* (L9); *"… ek stres, want ek weet nie hoe ek regtig gaan doen nie." [… I stress because I do not know how I am really going to do.]* (L1); and *"Ek stres as die juffrou sê sy gaan nou ons toetse vir ons uitdeel, want ek verwag altyd die ergste." [I stress when the teacher says she is going to hand back our test papers because I always expect the worst.]* (L6).

Against the general experiences of anxiety pertaining to evaluations in mathematics, one learner indicated that she finds mathematics to be an enjoyable activity because

she understands the work. Portrayed in her own words, this notion is reflected as: "*Ek voel gewoonlik rustig, want ek verstaan wiskunde so dit is vir my lekker." [I generally feel calm because I understand mathematics so it is something I enjoy.]* (L3). Accordingly, she does not experience evaluations as particularly anxiety provoking. Similarly, Learner 1 commented: *"… ek hou van ja goed te wees" [… I enjoy doing well.]* (L1), hereby highlighting a positive experience pertaining to the subject. Upon further exploration it became apparent that she holds herself to a high standard in general and therefore a lesser achievement is never satisfactory (L1).

The mathematics teacher listed frustration and anger as emotions that she witnessed in learners in addition to anxiety. She noted how learners become angry when they struggle with a specific mathematical equation which in turn may cause them to become despondent and angry. When in this state they are often unable to solve any mathematical problem effectively. *("… kinders wat dit nie regkry nie. Ek sien hoe angstig hulle raak dan is hulle kwaad en in daardie kwaad kan hulle niks reg doen nie.") [… children who do not get it right. I see how anxious they get and then they become angry and in that anger they cannot do anything right.]* (T). Guidance from the teacher may be experienced as encouraging when in such a state as it often enables learners to continue to try and solve subsequent problems. However, according to her, some learners view having to try and figure out what the solution is as too much effort and withdraw their active participation from the situation (T).

4.2.1.2 Personality trait

In this section I have included learners' ideas regarding their personality and character. Linked herewith are the manners in which such personality and character traits impact on their orientation towards mathematics and evaluations in the subject.

"Ek is nie die stres tipe eintlik nie." [I am not the kind of person that stresses easily.] (L4). Phrases such as this were put forth by some learners when describing themselves as a generally calm person. They conceive of this trait to be intrinsically part of their personality, as reflected in the following: *"Ek was nog net altyd so vandat ek klein is." [I have been this way since I was little.]* (L4). It is further attributed to influences whilst growing up, as alluded to by Learner 8: *"Dis seker soos hoe ek grootgeword het; ek steur my nie …" [It is probably how I grew up; I am not bothered*

…] (L8). Interestingly, despite initial suggestions of being calm by nature, as the interview with Learner 8 progressed, indications of serious concerns about achievement were conveyed, as became evident when questioned as to whether or not it matters which marks are achieved in mathematics. An affirmative statement was made in the form of: *"Ja, dit maak vir my saak …" [Yes, it matters to me …]* (L8). When asked whether others' perceptions of the participant are important, the following was shared: *"Nie noodwendig my maats nie, maar soos my ouers. Ek wil hulle nie teleurstel nie." [Not necessarily my friends but my parents. I do not want to disappoint them.]* (L8). Hereafter Learner 8 went on to explain what he aims to achieve in future and the importance of doing well in mathematics in order to materialise such aspirations (L8).

Further indications of calm mannerisms were portrayed by Learner 4. She stated: *"… as almal stres dan help dit nie rêrig veel nie …" [… when everyone stresses it does not really help …]* (L4). Holding this view means she tends to navigate in the opposite direction of stress. Upon further exploration it came to light that Learner 4 considers herself to be the calm one in her circle of friends. When alluding to the background of her calm nature it was stated: *"Ja, ek het dit al aangeleer van toe ek klein was …" [Yes, I learnt it when I was young …]* (L4). At present, Learner 4 is able to utilise her calm nature to keep both herself and her friends calm when facing evaluations in mathematics (L4).

By contrast, some learners indicated that they are more inclined to worry, both in general and during evaluations in mathematics (L1, L3, L5, L7, and L9). The occurrence of which was so eloquently conveyed by one learner in particular, *"… ek stres 'n bietjie te veel oor goed wat ek nie eintlik oor hoef te worry (bekommer) nie." [I stress a bit too much about things I really need not worry about.]* (L3). Despite recognising that there are instances that do not necessarily warrant a need to be concerned, this learner feels that worrying is an intricate part of her personality.

4.2.1.3 Physiological effects

Learners' overall experiences surrounding evaluations in mathematics may be influenced by certain bodily sensations. The nature and manner of such physical effects will be attended to in this section.

Learner-participants reported having experienced the following bodily reactions to anxiety brought on by an evaluative situation in mathematics: sweaty palms (L5), shaky hands (L7), shivers (L9), an increased heart rate (L1, L5), stiff shoulders (L1), and yawning (L9). While these reactions occurred during a mathematics evaluation, some learners also experienced bodily reactions in the time period leading up to an evaluative situation. These included changes in eating patterns with reports of sometimes eating more and at other instances less than normal (L1) and sleep disruptions in the form of difficulties in sleeping (L1, L4). While the majority of learners indicated the experience of some form of bodily reaction to anxiety, reports were made of learners experiencing, to their knowledge, no real physiological effects in response to evaluative situations in mathematics (L2, L3, L6, and L8).

According to the mathematics teacher, some learners talk to themselves, scratch their heads and yawn during a mathematics evaluation. The teacher hypothesised the existence of a possible link between mental processes and physiological effects. In her opinion, some learners' thoughts may put them in a negative space from which they find it difficult to escape *("… hulle denke daar ingesit en nou kan jy hulle nie daar uitkry nie …") […their thoughts put them in there and now you cannot get them out …]* (T). This proposed connection between learners' thoughts and the resulting experiences on both emotional and physiological level, is on par with the cognitive model (Beck, 2011). Furthermore, the teacher considers the reasons behind such thoughts to be unrealistic and fictional *("… dis vir hulle 'n ware ervaring, maar die oorsaak van die ware ervaring het hulle onnodig amper uitgedink.") […it's a real experience for them but the reason for this real experience they almost conceived of unnecessarily.]* (T). However, learners experience these as very real *("… vir daardie oomblik is dit vir hulle die waarheid.") […for that moment, to them it is true]* (T).

The experience of a panic attack by a learner may cause some frustrations on the part of the teacher (T). Normally, when a learner experiences a panic attack during an evaluation they are withdrawn from the test venue and the teacher tries to engage with the learner in a sympathetic manner even though they may not fully understand what the learner is going through. This is done by teachers regardless of the subject in which an evaluation is being written. The school principal plays a central role in the approach the teachers assume in such instances. The mathematics teacher states

that the principal encourages all staff to view a situation, particularly the experience of a panic attack, from the vantage point of the learner so as to be more empathetic to their situation (T). This is illustrated in the following: *"Die hoof het 'n ongelooflike begrip vir die kind ... As jy nog gedink het nee wat dan sê hy kyk net dit van die kind se kant af en dan sal jy sien." [The principal displays a great degree of insight into and compassion towards the child … If you thought no way then he would say look at it from the child's perspective and you will see.]* (T).

4.2.1.4 Cognitive effects

Social cognitive theory is grounded in thoughts on perception of self, beliefs and expectations (Woolfolk, 2010) which in turn correlates with the cognitions experienced in anxiety provoking evaluative situations (Sarason; Schwarzer & Jerusalem, as cited in Cassady & Johnson 2001). Accordingly, the influence of thoughts on learners' experiences in mathematics will henceforth be discussed.

Learner-participants indicated that they experience difficulties in concentrating during an evaluation in mathematics as thought distractions make it challenging for them to focus by pulling their attention away from the mathematical task at hand (L1, L6). This occurrence is illustrated by the following description: *"… ek konsentreer nie altyd as ek wiskunde skryf nie … ek kan nie altyd baie goed konsentreer op die toets nie, so ek dink aan baie goed ..." [I don't always concentrate when I'm writing mathematics … I cannot always concentrate on the test so I think of many things ...]* (L6). The mathematics teacher attests to such experiences as she postulates that it becomes evident in learners' eyes when they have consciously distanced themselves from the situation and are lost in thought (T).

In general, distracting thoughts are often centred on beliefs about a lack of ability to successfully solve a specific mathematical equation *("… sodra ek iets sien in die toets wat ek nie weet hoe om dit te doen nie ...") [… when I see something in the test I do not know how to solve ...]* (L6). Further sub-categories indicative of thought distractions include inadequate preparation for the evaluation (L2, L6); trying to conceive of all the information covered in preparation for the evaluation (L7, L8); and a lack in ability to master the content of the test *("… ek is nie goed genoeg om dit te doen nie.") [… I am not good enough to do it.]* (L6).

Furthermore, reports were given of self-talk that occurs both prior to and after an evaluation. These discussions of sort are focused on telling oneself: *"Nee, dit gaan alles uitwerk." [No, it's all going to work out.]* (L7). It also focuses on consoling oneself after a test by acknowledging that if the results are poor there will be other evaluative opportunities to try and achieve a better grade *("… veral as jy weet jy gaan nog 'n toets daaroor skryf …") [… especially when you know you are going to write another test on it …] (*L7); and by reminding oneself that, provided more effort is made to gain an understanding of the work prior to the evaluation, better marks can be obtained (L1, L3). Notions of the latter are reflected in the following: *"Dan sê ek vir myself ek gaan maar harder moet leer en soos 'n paar ekstra wiskundeklasse doen om net die goed te verstaan." [Then I tell myself I will have to study more and attend a few extra mathematics classes in order to better understand the work.]* (L1); and *"… ek gaan nou harder leer …" [… now I am going to study more …]* (L3).

Against this backdrop of learners who intend to adopt different approaches in future, one conceived that had she studied more it would have made a difference but failed to see that she is potentially able to alter the course of events regarding future evaluations *("… partykeer voel ek half teleurgesteld omdat ek weet ek kon nog harder geleer het en ek kon nog beter gedoen het, maar ja dis nou verby en daar is niks wat ek nou daaraan kan doen nie." [… sometimes I feel fairly disappointed because I know I could have studied harder and done better but it's over now and there is nothing I can do about it now.]* (L6).

Thought distractions may also be linked to the experience of drawing a blank during an evaluation, as shared by Learner 1: *"Ja, baie keer dan slaan ek soos heeltemal blank en so, dis nogals nie lekker nie." [Yes, many times I draw a complete blank and it's rather unpleasant.]* (L1). Descriptions were given of what precipitates such an experience *("Ek stres nogal baie voor die tyd … as ek hard geleer het dan stres ek meer as wat ek minder geleer het, want dan is ek, weet ek moet goed doen …") [I stress a lot before the time … if I studied hard then I stress more than when I didn't study as much because I then know I have to do well.]* (L1) and how it is overcome *(… ek probeer myself net soos kalm kry … en net soos rustig half asemhaal … dat ek net kan goed dink.") [… I try to calm myself … and to just breathe calmly … so that I can think well.]* (L1).

As reports of drawing a blank during evaluations were made, I sought to gain further insight on the matter from the perspective of the mathematics teacher. She reiterated the influence of learners' thought processes on their experiences. According to her, once confronted with a mathematical problem that seemingly poses too big a challenge to the learner, they may think themselves into a negative space within which they are unable to even solve subsequent less difficult mathematical problems posed in the evaluation *("… dan raak die volgende som wat eintlik nie moeiliker is nie vir hulle 'n groter probleem …") [… then the next sum becomes a bigger problem for them even though it's no more difficult …]* (T). These circumstances are marked by anxiety and during such an experience learners may claim to have drawn a blank which in turn results in inadequate information being put down on paper *("… die angstigheid kan hulle, kan daardie blokkasie veroorsaak, daardie ek het blank geslaan … en op die ou end gaan daar niks aan op die papier nie en hulle noem dit ek het 'n blank geslaan.") [… the anxiety can cause those blockages of I drew a blank … and in the end there is nothing on their answer sheet and they call that I drew a blank."]* (T). According to the teacher this term does not accurately describe the occurrence *(… dan dink ek vaderland, waarom? Dit is eintlik 'n verkeerde beskrywing.") [… then I think, why? It is actually an inaccurate description.]* (T).

The mathematics teacher further explained that while some learners experience thought distractions, others, by contrast, make conscious efforts to focus all their attention on the mathematical equations they are confronted with during an evaluation (T). They do so by cutting themselves off from the outside world and by focusing all their attention on their own engagement with a particular mathematical problem *("Party is mal oor daardie uitdaging, hulle wil gaan sit, 'moet nie nou my pla nie, ek wil hom nou uitsorteer'. Hulle sny hulle heeltemal af … hulle fokus ongelooflik ...") [Some are crazy about that challenge. They want to sit and work on it, 'do not disturb me; I want to sort it out now'. They cut themselves off … they display incredible focus …]* (T).

In addition to its occurrence during an evaluation, thought distractions may also occur during the preparation phase of an evaluation. Whilst preparing for an evaluation some learners may be under the impression that they have studied for many hours which may not be an accurate portrayal of events as thought distractions would most

likely have detracted from sustained active engagement with the work. This occurrence is portrayed in the ensuing description given by the mathematics teacher: *("… party kinders dink hulle leer … en dit is wat die vak so anders maak as ander vakke, is as jy so sit al is jy besig, is jy nie besig om te leer nie, want jy is nie hier nie, jy is nie gefokus (nie) … jy gaan vir jouself sê ek het nogal baie ure ingesit, maar eintlik het ek nie iets ingesit nie en as jy nie 'n kopskuif maak van dat ek ook hier moet wees nie is dit nie die moeite, dan doen jy eintlik niks nie en hulle kom dit baie laat agter.") [… some kids think they study … and that is what makes this subject different from other subjects, it's that if you sit and even though you are busy you are not busy studying because you are now here, you do not focus … you are going to tell yourself I put in many hours but in reality you did not put in anything and if you do not make a mind shift to I also need to be present then it is not worth the trouble, then you are actually doing nothing and they only realise it later on.]* (T).

4.2.1.5 Motivation

The discussion in this section is founded on the premise that individuals' actions are based on certain reasons, incentives and encouragements – a notion also derived from the literature review covered in chapter 2. These act as motivation and may spur individuals on to take certain actions. The manner in which this relates to the experience of evaluations in mathematics by participants will henceforth be explored.

Learner-participants indicated three main sources of motivation, namely friends, parents and themselves. Firstly, their friends would often speak words of encouragement in instances when they battle with the work for an ensuing evaluation *("… my vriendinne ook hulle is partykeer soos: "Nee man, jy doen altyd goed" of soos "Wees rustig, jy gaan dit ace" of soos ja dan is ek baie gemotiveerd en soos jy kort daardie persoon wat soos daar is vir jou wanneer jy dit nodig het.") [… my friends too, they will sometimes say: "No, you always do well." or "Stay calm. You'll ace it." or yes, then I feel motivated and you need someone that's there for you when you need it.]* (L7). The motivational role of friends may also extend into the debriefing space following an evaluation. One learner alluded to this when he stated: *"… ek en my vriende … gewoonlik na 'n toets en ek nie lekker geskryf het nie dan praat jy … en dan sien jy julle twee het omtrent dieselfde goeters geskryf dan voel jy nou al klaar beter en meer gerus as jy net praat oor dit met iemand." […* *my friends and I …*

normally after a test, if I did not write well then you speak … and then the two of you realise you wrote almost the same things then you feel better and more at ease after having spoken to someone.] (L9).

Another source of motivation is parents. When speaking on the influence of her parents, a participant stated: *"Hulle probeer my reg help; ek moet harder leer. Hulle motiveer my." [They try to help me; I must study harder. They motivate me.]* (L5). Other learners were in agreement as evident in sharing that their parents' display of belief in their abilities is a strong motivating factor.

Lastly, learners also seemed to motivate themselves. Some are unaware of the personal factors influential to their own motivation or experience difficulties in motivating themselves (L4, L8).Others are able to accurately pinpoint a vision for their future as a motivator and driving force for action. The statement made by one of the learner-participants exemplifies the latter: *"… ek aanvaar net wiskunde is baie belangrik vir soos enige werk wat 'n mens doen en ja as ek myself moet sien dan wil ek myself maar ryk sien … dit is ook my dryfkrag, want sommige mense is in 'n omstandighede waar hulle nie soos veral, soos by die huis of iets, soos waar dit nie so goed gaan, hulle is arm dan sien jy hoor ek wil uit hierdie omstandighede uitkom, ek wil vir myself kan sorg en nie stres oor hoeveel 'n brood kos (nie)." [I just accept that mathematics is very important for any job a person might do and if I picture myself I would like to be rich … That is my motivation because some people live under circumstances where things at home are bad. They are poor and you can see how they struggle. I want to take care of myself and not worry about the cost of a loaf of bread.]* (L7).

4.2.2 Influences on the experience of mathematics test anxiety

4.2.2.1 Downhill trend

A downhill trend is conceived of as a continuous negative tendency in achievement brought on by a particular life event. One learner indicated a drop in her marks, including mathematics, from the onset of her grade 10 year *("Op die oomblik is ek bekommerd baie oor my skoolwerk, want … hierdie jaar het dit baie downhill (afdraand) gegaan.") [At the moment I am worried about my schoolwork because … this year it went downhill.]* (L1). She further explained that she changed schools at

the beginning of the year and due to possible challenges in adjusting to her new academic environment experienced an overall decrease in her marks (L1). Another learner reported obtaining lower marks than expected in mathematics, which is in contrast to previous terms *("… ek het nou hierdie kwartaal vir wiskunde … nie so goed gedoen soos wat ek gedink het ek gaan doen nie …") [… this term I did not do as well in mathematics as I thought I would …]* (L2).

The teacher conceives of the notion of a downhill trend in a slightly different manner. She states that often during an evaluation in mathematics some learners get so caught up in their own panic that they struggle to answer the questions, even the ones that are mathematically predetermined to be easier to solve. This in turn results in minimal information being portrayed on their answer sheets once handed in after the test time period had elapsed *("… niks op die papier nie …") [… nothing on the paper …]* (T). Among this group of learners who become entangled in their own struggles, some simply give up *("… daar is 'n tipe kind wat sukkel met wiskunde en dan nie meer begin worry (bekommer/omgee) nie en dan dit heeltemal los. Hy het opgegee.") [… there is a type of child who struggles with mathematics and then does not worry anymore and then does not engage with it anymore. He gave up.]* (T). By contrast, others persevere despite their anxiety *("… maar die een wat nog angstig is … hy doen meer") [… but the one that is anxious … he does more.]* (T). Individuals within the latter group often achieve more than those who simply declare defeat prior to the proverbial end whistle having been blown (T).

4.2.2.2 Reasons to worry

There exists an array of factors which are concerning to learners and that may cause them to worry. Based on the data gathered, I will divide these factors into two broad sub-categories; general concerns and those specific to mathematics.

Within the first sub-category, the following concerns were prominent: problems of a personal nature often rooted in close relationships with others (L1, L4); sport or other extramural activities (L7, L9); and family dynamics, home life and parental relationships (L1, L2). The mathematics teacher affirms these notions by postulating that circumstances at home undoubtedly spill over into the school context, thereby affecting learners' academic functioning (T). She regards this as the primary factor

causing learners to worry and deems it more important than any challenges faced in a specific subject *("Ek dink hulle kom met iets van die huis af en dan hang dit af van die vak en sekere vakke maak dit hulle rustiger, maar ongelukkig in my vak, wat wiskunde is, kom dit absoluut uit as daar iets anders is wat vir hulle pla … die vak alleen is vir my nie eintlik die groot oorsaak altyd nie.") [I think they come with something from home and it depends on the subject and some subjects make them calmer but unfortunately in my subject, which is mathematics, it shows if there is something else that is bothering them … the subject alone is, to me, not always the main cause.]* (T). Furthermore, problems within close friendships may negatively impact on learners' self-image and in turn influence their engagement with schoolwork in general *("Selfbeeld is vir my die grootste rede en dan moet 'n mens teruggaan na wat is die oorsaak van swak selfbeeld … tienerprobleme van vriende wat weer terugkom na selfbeeld toe … wat 'n ma en pa aan jou doen met jou selfbeeld, jy voldoen nie aan hulle verwagtinge nie.") [Self-image, for me, is the biggest reason and then one has to go back to what causes poor self-image … teen problems with friends which comes back to self-image … what a mom and dad do to a child's self-image, the child does not meet their expectations.]* (T). In essence, the teacher thus affirmed that many external factors may influence learners' anxiety concerning mathematics (T).

The second sub-category focuses on reasons to worry that are specific to mathematics. As the primary causes of concern, learners listed the following worries: inadequate preparation for an evaluation (L2, L4); time constraints with regards to either preparation time or writing time (L7, L9); and disappointing their parents (L1, L4, L8). In close relation to parental concerns is the manner in which parents enforce discipline. A noticeable theme that emerged from the data was that having strict parents who uphold their child to high standards have a major impact on the child's concerns about possibly disappointing their parents (L1, L4, L5, L8). Concerns about achievement being unsatisfactory to their parents cause learners to worry about their marks, as illustrated by: *"… my ouers is nogals baie streng oor punte … my ouers verwag van my om soos half 80 persent … te kry." [… my parents are rather strict about marks … my parents expect me to get 80 percent.]* (L1).

In addition, concerns during the preparation phase revolve around feeling as though not enough time was spent preparing for the test either because of personal choices (L4, L8) or that the teacher provided too short notice of the test (L9); and the content of work that learners need to be familiar with for the test poses an obstacle (L2, L3, L4, L6, L8). When the test focuses on a part of the work a learner does not have a good understanding of (L3, L4) or when there are various components of the work they feel they did not devote enough time to mastering (L6), learners become anxious in anticipation of having to write the test.

Within the mathematics classroom the teacher sometimes noticed that a learner's approach to her subject is not necessarily, in her opinion, the method best suited to address mathematical problems. Creative and artistic learners, for example, may have a less structured approach to problem solving than deemed necessary and effective by the mathematics teacher *("… sy is 'n baie kunstige persoon en sy wil alles met 'n kunstige sin benader en dit werk nie en dan is sy so frustreerd in hierdie wiskunde.") [… she is a very artistic person and wants to approach everything in an artistic manner and it does not work and then she becomes frustrated with mathematics.]* (T). This particular learner showed insight into her own approach to mathematics, stating that mathematics requires numbers as opposed to words and necessitates that one's brain has to think differently when engaged with the subject matter *("Omdat dit meestal syfers vat en nie woorde nie en ook dat jou brein op 'n ander manier moet werk.") [Because it mostly requires numbers and not words and that your brain has to work differently.]* (L7). This poses a personal challenge for her.

4.2.2.3 Expectations and pressure

This section is concerned with the sources and nature of factors which result in learners' experience of having to reach certain outcomes. These in turn manifest as expectations and accompanying pressure. The impact hereof on learners' well-being will be explored.

Learner-participants recounted various sources of and reasons for expectations and pressure felt. Some reported placing pressure on themselves to reach a certain level of accomplishment *("… ek dink dit is maar meer my eie verwagtinge, want ek wil goed doen …") […I think it is more my own expectations because I want to do*

well…] (L2); *(“… probeer ek my punte so hoog as moontlik hou.”) […I try to keep my marks as high as possible.]* (L9). One particular learner indicated that at times when she studied more prior to an evaluation, she also stressed more as she felt the added pressure of having to do well, based on the amount of effort put into her preparations (L1). Another stated that she puts vast amounts of pressure on herself to attain high marks due to the fact that she tends to expect to do poorly *(“… ek verwag altyd die ergste, want ek weet dit gaan nie goed gaan nie …”) […I always expect the worst because I know it is not going to go well …]* (L6) and therefore tries to compensate during her preparation phase (L6).

Parents are another source of pressure (L1, L5). Learner-participants, who come from a family where academic achievement is valued and where parents enforce strict rules, find that their parents hold certain expectations of what their child should achieve and exercises pressure on them to do so, as discussed in the section on *Reasons to Worry*. Against this background, there were few exceptions of learners who reported not feeling pressured to meet certain expectations, not from their parents (L3, L8) nor themselves (L3). Interestingly, Learner 8 indicated personal motivation as opposed to pressure as a factor influential in attaining certain achievements *(“Nee, ek dink nie ek plaas druk op myself nie. Ek moet myself motiveer om goed te doen.”) [No, I do not think I put pressure on myself. I have to motivate myself to do well.]* (L8). This notion is reminiscent of the self being a motivating factor in taking certain actions concerning mathematics.

The mathematics teacher highlights three sources of pressure to reach certain achievements in mathematics. Firstly, parents hold certain expectations and ideals for their children. Some are of the opinion that due to the fact that they themselves did well in mathematics at school level, their child should do the same. Other parents hold the view that their child should do well in mathematics even though they themselves fared poorly in the subject *(“… die ouers se druk kom baie keer van ek wil niks wiskunde gedoen het nie, my kind moet dit nou doen of die ander kant ek was fantasties in wiskunde”) […the parents’ pressure often comes from I did not want to do mathematics, my child has to do it or the reverse I was fantastic in mathematics …]* (T). If their child finds it difficult to reach certain benchmarks in achievement, parents turn to the teacher to address issues of underachievement (T).

Secondly, the areas of tertiary study many learners in the school are interested in require mathematics as a prerequisite in applying to enrol for the specific degree. As these learners (L1, L3, L5, L7, L8) already have distinct ideas of what they would like to study, they are also aware of the application requirements and therefore place additional pressure on themselves so as to reach their own academic expectations. These pressures also act as motivational factors that direct learners toward pursuing that which they envision for their future. According to the mathematics teacher some learners aspire to belong to the so-called elite group who achieve success in mathematics and are accepted into university *("… toelating tot universiteite en die kinders wat sukses in wiskunde behaal raak al hoe minder so hulle sien hulle is dan 'n uitgelese groepie.") [… acceptance into university and the number of children who succeed in mathematics is decreasing so they view themselves as an exclusive group.]* (T). Holding this view acts as a further motivational factor too (T).

Lastly, the media tends to inflate the importance of mathematics as a subject necessary for further study. This in turn influences learners', as well as their parents' perceptions on the matter *("Ek dink dat die media blaas dit op … en dan kom die ouers, spring dan ook op daardie wa …") [I think the media inflates it … and then parents also jump on the bandwagon …]* (T).

As is evident from the above discussion, various sources of expectations and pressure were identified by the participants and some of these are closely linked with the motivational factors which influence learners' actions pertaining to mathematics. There does, however, appear to be some divide between the origins of expectations and pressure experienced. The statements made by one learner-participant served to illustrate how different reasons from various sources can combine in exerting certain pressures on an individual (L9). When asked about the expectations of others and self, as well as the accompanying pressure, he said: *"Ja, dit maak saak. Ek is 'n top 10 leerling, probeer ek my punte so hoog as moontlik hou." [Yes, it matters. I'm a top 10 learner and I try to keep my marks as high as possible.]* (L9). Within the context of the discussion, it was evident that he intends to maintain this standard and puts pressure on himself to do so but also wants to meet the expectations of his parents and teachers. Although this is a general academic orientation he holds toward all subjects, it is also applicable to mathematics. This is another example of

how pressure exerted on oneself acts as a motivational factor concerning mathematics.

4.2.2.4 Others' perceptions

The views significant others hold of individual learners' achievement in mathematics will now be explored. The discussion will focus on grouping together certain individuals in the lives of learners and the views they generally hold.

The individuals whose perceptions are of importance to learners can be grouped into three categories, namely friends, parents and teachers. Friends are a source of support and they tend not to pass judgement especially when the outcome of a mathematics evaluation is negative (L1, L5, L7). Interestingly, one learner noted that her friends appear to develop more respect for her when she does well in a test *("… jou vriende as jy sê nou maar goed doen in iets dan het hulle meer respek vir jou …") […say you do well in something then your friends have more respect for you …]* (L7).

The central emotions related to parents are support and disappointment. Learners seem to think that their parents will most likely be disappointed if they achieve poor marks in mathematics and conversely those learners aim to not disappoint their parents (L1, L5, L6, and L8). A cognitive understanding of the process thus contributes to the experience of pressure and anxiety which illustrates the manner in which thoughts impact on both emotions and actions. As such, this occurrence relates to Beck's (2011) cognitive model.

Disappointment is also related to teachers (L6). Upon obtaining poor marks in the subject, some learners feel as though they have disappointed their teacher *("… die onderwysers … ek weet nie, ek voel partykeer as ek swak doen dan dink hulle ek werk nie hard genoeg nie … ek kry daardie gevoel …") […the teachers … I don't know, I sometimes get the feeling if I do poorly then they think I didn't work hard enough … I get that feeling …]* (L1). However, when obtaining good marks in mathematics these learners appear to be liked more by the teacher. This perspective on the teacher's perceptions are reflected in: *"… party onderwysers hou van die manier hoe jou punte doen, so as jou punte goed is dan is jy soos 'n goeie kind, as jou punte sleg is dan hou hulle nie so baie van jou nie …" […some teachers pay*

attention to your marks so if you do well then you are a good child, if your marks are poor then they don't like you as much …] (L7). Although most learners care what others think *("Ja, dit maak saak.") [Yes, it matters.]* (L9) and are influenced by their perceptions, there was the exception of a learner who showed no concern for the opinion of others (L3).

4.2.2.5 Others' influence

In elaboration on the previous discussion, this section will focus on the influence significant others, as identified above, have on learners. Significant others in the lives of learners may have a profound impact on their academic work, including mathematics.

Learners stated that their parents and friends would often display belief in their abilities to succeed in mathematics, lend assistance upon encountering challenges with the work, motivate them to do their best during an evaluation, and reiterate the value of remaining calm (L5, L7). Furthermore, indications were given that it is helpful to debrief with friends after an evaluation as it creates the opportunity to hear how others did, what they may have found challenging and how they went about solving specific mathematical equations (L2, L9). These factors constitute the positive side of others' influence.

On the other hand, in instances when parents and friends display high levels of anxiety about a specific evaluative situation it tends to negatively impact on the learner concerned by making them more anxious and fearful of disappointing significant others by not achieving as highly as they expect the learner to (L1, L4, L5, L8). The mathematics teacher further elaborated on the negative component of significant others' influence pertaining to evaluations in mathematics. According to her, learners are greatly concerned with the views others have of them. Therefore, if results obtained for a mathematical evaluation do not meet the expectations of significant others this impacts negatively on the self-image of the particular learner (T). Another factor which can potentially have a negative impact on a learner's self-image is linked to their natural ability to succeed in mathematics.

The mathematics teacher also reported that parents often push their child to pursue mathematics on a level that may be above that which the learner is capable of.

During the learners' grade 9 year when subject choices are being made in preparation for grade 10, the school advises the child and the parents on subject choices. What the school sometimes found is that parents want their child to pursue mathematics on a level higher than that advised by the school (T). This occurrence is illustrated in the following statement made by the mathematics teacher: *"… in graad 9 dan sê ons vir hulle (ouers) jou kind kan nie wiskunde neem nie … uhm, maar my kind is ontsettend slim, ek weet my kind is slim, ek gaan vir hom laat begin leer volgende jaar … dan is dit die ouer wat wil begin leer, nie die kind nie en dan sê hulle ek gaan vir die kind sê graad 10 begin met wiskunde … ek sal vir hulle laat sit en werk … en dan is die werketiek net nie daar nie." [… in grade 9 we tell them (parents) that their child cannot continue with mathematics … uhm but my child is clever, I know my child is clever, I will let him study next year … then it's the parents that want to start studying not the child and then they say I will tell the child grade 10 starts with mathematics … I will see to it that they sit and work … and then the work ethic just isn't there.]* (T) Upon continuing along this path, when learners face challenges with subject content, the parents often turn to the teacher for assistance *("Ek het nou 'n kind wat 'n pa vir my gesê het jy sorg dat my kind elke dag vir ekstra wiskundeklas kom, ek moet nou daarvoor sorg, die kind wil nie daar wees nie.") [I have a child whose father told me you will see to it that my child attends extra mathematics classes every day, I have to make certain of that and the child doesn't want to be there.]* (T).

4.2.2.6 Comparisons with others

Learners made no explicit reference to comparing their marks in mathematics to that of their peers. The response of Learner 6 when asked whether he compares his marks to that of his peers: *"Nee, nie regtig nie." [No not really.]* (L6) reflects the general feel of learner-participants. It seems implicit that they are rather in competition with themselves as opposed to others. Being attuned to one's own attainment is a reflection of the belief one has in reaching certain levels of achievement which in turn is indicative of one's self-efficacy (Woolfolk, 2010).

4.2.2.7 The importance of mathematics

I endeavoured to gain some insight into the participants' views on the importance of mathematics. Among the group of learner-participants, some indicated that they generally consider mathematics to be an important subject (L1, L3, L5, L7, and L8). In relation to this view, the majority of these learners stated they believe mathematics to be a prerequisite for entry into university and due to the fact that they each have a distinct idea of what they intend on studying after school, they know they need to do well in mathematics (L3, L5, L8). Similarly, others indicated that even though they do not yet have a clear indication of what their future will entail upon completing grade 12, they do consider mathematics important in paving the way for their futures (L1, L7). By contrast, there was one learner without a clear idea of what she would like to pursue after matriculating but she displayed certainty in knowing that whatever she does will not be focused on mathematics (L6).

There appears to be a direct parallel between learners' views on the importance of mathematics and the teacher's perception on how learners view the subject. The teacher stated that according to learners, doing well in mathematics counts as a far greater achievement than doing well in any other subject. Similarly, the standard by which the learners measure doing well in mathematics differs from that in other subjects. To them obtaining 60% in mathematics is a great achievement whereas getting a mark of 80% in another subject is considered as having done well *("As hulle goed gedoen het in wiskunde en dan is goed nou in hulle terme goed, 60 en hulle kry 80 vir 'n ander vak, die wiskunde oorheers.") [If they did well in mathematics and that is well in their terms, 60 and they obtain 80 in another subject, the mathematics overrides.]* (T). In essence, the outcome of a mathematics evaluation surpasses any achievement reached in another subject *("Die uitslag van wiskunde oorheers heeltemal.") [The outcome of mathematics always supersedes.]* (T).

The various components pertaining to the importance of mathematics, as described by the participants, are reflected in the words of one learner-participant: *"…ek wil graag 'n meganiese ingenieur eendag word en dit is van die goed soos wat ek regtig in belangstel en dit is vir my baie lekker in daardie beroep so ek moet goed doen daarin. My ander vakke is goed, ek kan, is reg, maar my wiskunde moet ook reg wees." [I want to become a mechanical engineer. It's something I'm really interested*

in and to me it seems nice to be in such a career. Therefore, I must do well in it. My other subjects are good, I can, it's alright but my mathematics also has to be right.] (L8).

Furthermore, external factors also play a role in why learners perceive mathematics as a criterion for a successful future. The teacher is of the opinion that the importance of mathematics is overemphasised in the media *("Ek dink dat die media blaas dit op …") [I think the media blows it up …]* (T). As discourse hereof falls within the public domain, parents then make their children aware of this notion *("… die ouers spring dan ook op daardie wa …") [… the parents then also jump onto the wagon …]* (T). Together with universities making a pass rate in mathematics part of the entry requirements to study certain courses, learners then form their own ideas about the importance of this subject and having to succeed in it (T).

4.2.2.8 Mathematical challenges

The nature of challenges posed by mathematics will henceforth be described. All perspectives portrayed are based on the understandings of the mathematics teacher.

The mathematics teacher elaborated on the vast nature of challenges surrounding mathematics. She proposed that mathematics necessitates a different manner of thinking than other subjects, specifically higher order thinking *("… dit is nie enkelrigting denke nie … daar is vakke wat so bietjie op 'n hoër vlak denke vrae vra, maar dit is amper asof ons dit altyd doen.") [… it is not unidirectional thinking … there are subjects that pose some higher order questions but it is as if we always do it.]* (T). According to her, some learners enjoy the challenge in thinking mathematics offers. These are the learners who often do not wish to be disturbed when engaged with mathematical equations and seek to find the solutions on their own. They also tend to display perseverance in their efforts to reach the appropriate outcomes. Others, however, may lack such work ethic. This is often the case when learners have been forced by their parents to take mathematics as subject when they would personally opt for a different subject. These learners often feel debilitated by the challenges mathematics poses *("… maar dit frustreer party kinders. Dit is nie vir hulle 'n uitdaging nie, dit is vir hulle 'n frustrasie.") [… but it frustrates some learners. It's not a challenge for them, it's a frustration.]* (T). Therefore, they often avoid finding the

errors in their own work and rather look to their teacher for assistance. In this manner they may not develop the necessary skills to succeed independently.

A challenge faced by both the mathematics teacher and the learners is the vast gap in subject content and difficulty level between grade 9 and grade 10 and the accompanying effort it requires from learners *("… niemand het ooit vir hulle geleer hoe om meer van hulle kant af te gee nie.") [… no one ever taught them how to give more from their side.]* (T). Therefore, when learners progress from grade 9 to grade 10 some find the adjustment extremely difficult. To accommodate for this discrepancy and in an attempt at narrowing the gap, the mathematics teacher tries to incorporate a degree of challenging work which is above the level required for grade 9 into their classwork. However, due to the fact that such subject content does not form part of the official Western Cape Education Department's syllabus, learners may not be evaluated on such content *("… ons probeer in graad 9 dit 'n bietjie moeiliker maak, maar van bo af sê as jy 'n kind iets vra in die eksamen wat bo die syllabus is, buite die syllabus is en die kind druip dan sit daardie kind deur …") [...in grade 9 we try to make it a bit more difficult but from above they tell us if a child is asked something in an exam that falls outside of the prescribed syllabus and the child fails then the child needs to be put through …]* (T).

The teacher's intent is to better prepare learners for what is to be expected in grade 10 but due to bureaucratic factors the following often occurs: at the end of grade 9 learners who obtain a 60% average are under the impression that they are competent enough in mathematics to continue with Mathematics as opposed to Mathematical Literacy in the following year. Due to the aforementioned gap in subject content between the two grades these learners then often obtain a 40% average in grade 10 which is contrary to what they expected *("… en dan kom hulle goeie punte, 60%, dan dink hulle maar ek is okei ek het 60, kom hulle in graad 10 dan kry hulle 40.") [… and then come their good marks, 60%, then they think I'm OK I have 60, come grade 10 then they get 40]* (T). The shock of the discrepancy between expectation and results obtained should prompt learners to make the necessary changes in their approach to mathematics and adopt a culture of learning but unfortunately in the teacher's experience not everyone makes the change (T).

4.2.2.9 Mathematics learners' needs

The mathematics teacher deemed it necessary to discuss learners' needs with regards to mathematics as these aspects are interlinked with the challenges some may experience in the subject. From her perspective, learners who struggle in mathematics seek patterns according to which they can solve equations in a step-by-step manner *("… jou kind wat bietjie sukkel soek patrone en daar is nie altyd patrone in wiskunde nie.") [… your child that struggles seeks patterns and there aren't always patterns in mathematics.]* (T). Similarly, once they find the solution to a particular kind of mathematical problem learners want to know whether following those specific steps will always lead them to solving the equation. They often ask: *"Gaan dit altyd so wees?" [Is it always going to be like that?]* (T). However, such forms of predictability cannot be guaranteed *("… in daardie situasie gaan dit altyd so wees, maar 'n situasie is nie altyd dieselfde nie.") [… in that situation it is always going to be like that but a situation isn't always the same.]* (T). Furthermore, the mathematics teacher considers it interesting that learners do not always recognise similarities between different mathematical equations when in fact a sense of familiarity is what they seek (T).

A need displayed by learners who struggle in the subject, is additional assistance from the teacher (L4, L7, T). They would often ask for extra clues to help them solve an equation (T). The teacher states that within a class situation such assistance can be provided but it is not possible under evaluative conditions *("… hulle wil baie graag dadelik weet hoe om 'n som te doen. As hulle nie dadelik weet nie dan wil hulle hulp van my af hê en in 'n toetssituasie kan hulle nie kry nie.") [… they desperately want to know how to do a sum immediately. If they don't know immediately they want assistance from me and in a test situation they cannot get help.]* (T). Nonetheless, she finds that because learners have become dependent on additional assistance within the class context and consequently may not have developed the necessary skills to work independently, they continue to seek assistance during evaluative situations. Under such circumstances when assistance cannot be given, it may lead some learners to experience heightened levels of anxiety and possibly the accompanying symptoms of a panic attack *(… dan is daar nie 'n wenk vir hulle of so-iets nie … dan begin hulle al klaar bietjie vinniger asemhaal …") [… then there isn't a*

hint or something of the sort for them … then they already begin to breathe quicker …] (T).

4.2.3 Resources

4.2.3.1 Coping mechanisms

Learners employ various techniques that serve as coping mechanisms to help them deal with evaluations in mathematics. Indications of coping mechanisms employed by learners, as mentioned by either themselves or the mathematics teacher, will henceforth be discussed.

Concrete techniques for remaining calm include breathing slowly (L4), as well as thinking positive thoughts such as reminding oneself that you had studied and put in the necessary effort therefore you will be able to productively engage with the content of the test (L3). Another way to remain calm is to trust in one's faith and to pray (L1, L7). Two learner-participants indicated that this helps them better prepare and deal with the stressors surrounding mathematics evaluations *("Ek bid …") [I pray …]* (L7); and *("Ek is 'n Christen, so ek bid nogals baie oor die dinge en so ek nie rêrig met iemand praat daaroor so dit is die enigste manier hoe ek deurkom …" [I am a Christian so I pray a lot about these things and so I don't really talk to anyone about it so it is the only way I get through it …]* (L1). The outcome of these techniques is thus remaining calm prior to and during an evaluation (L1, L3, L4, and L5).

Self-talk is another phenomenon that learners reported on. Learner-participants indicated that they tell themselves they are capable of handling the content they are being tested on in an effective manner (L5) and most importantly remind themselves that everything is going to be alright, as expressed by Learner 7: *"Ek sê vir myself dit gaan alles uitwerk." [I tell myself it is all going to work out.]* (L7). The words of Learner 3 are in agreement: *"… dis ok … dis nie eintlik nodig om myself te bekommer daaroor nie." [… it's ok … it's actually not necessary to worry myself over it.]* (L3).

Furthermore, actively engaging with the subject content on which they will be tested prior to an evaluation is particularly important to learners. They make attempts to do so by attending extra mathematics classes (L1, L5, L7); doing additional exercises

(L3, L7); gaining a thorough understanding of the work (L1, L3, L7, L8, L9); and scheduling specific time slots in which to do mathematical exercises in an aim to spend short periods of time practising every day so as to be less anxious about the scope of work to prepare immediately prior to a specific evaluation (L7). Employing the latter technique also allows one to get a good night's rest which provides the brain with time to consolidate that which was learnt in preparation for the evaluation (L7).

A coping mechanism employed during an evaluation is to go through the paper a second time after having completed the questions in order to double check and verify answers (L9). Time is a crucial element in this regard and being able to answer the question paper in a timeous manner acts as a coping mechanism (L7, L9), as is evident in the following statement: *"… ek voel baie beter as ek die toets geskryf het en ek het klaar geskryf en ek het hom dan nog een keer, twee keer deurgegaan, dan voel ek en daar is nog 'n tydjie oor dan voel ek net meer gerus." [I feel better when I've finished writing the test and there's enough time for me to go through it once or twice. Then I feel at ease.]* (L9).

The themes discussed above may be conceived of as positive coping mechanisms. There are, however, learners who employ techniques that may be conceived of as less constructive. These will be explored in the following sections.

One learner indicated that she does not openly portray her emotions and consequently does not show when she is worried about an evaluation nor speaks to anyone about her concerns pertaining to the test *("… ek praat nie rêrig daaroor nie; ek hou dit maar alles vir myself. Ek wys nie dat ek bekommerd is oor iets nie.") [… I don't really talk about it; I keep everything to myself. I don't show that I am worried about something.]* (L1). Another finds solace in knowing that mathematics will not be an important factor in the choices she is most likely to make about her future (L6). In instances when evaluations are for practice purposes and becoming better acquainted with the work or when a particular test does not contribute a great deal toward learners' final mark in mathematics, this also serves to put the minds of some learners at ease (L7).

The mathematics teacher is of the opinion that in general learners do not possess the necessary skills to find ways of lessening their anxiety about an evaluation. This is a skill they have yet to master. She did, however, state that the only ones moving toward the acquisition of such skills are the learners who see psychologists because of psychological issues such as anxiety and who receive assistance in developing the necessary techniques to calm themselves prior to, during and after an evaluation. In instances when learners feel particularly anxious during an evaluation it is suggested that they excuse themselves from the venue and take a quick walk outside, focus on their breathing or have a drink of water *("… kinders wat sielkundiges sien, sê vir my dit is wat die persoon vir hulle gesê het hoe moet hulle doen as hulle angstig raak.") [… children who see psychologists tell me that's what the person said they should do when they feel anxious.]* (T). In agreement with psychologists' suggestions, the mathematics teacher is of the opinion that these techniques may be of help to learners who are prone to experiencing panic attacks (T).

4.2.3.2 Seeking assistance

Upon encountering challenges in mathematics learners may seek assistance from external sources. While some are inclined to ask for help when needed (L2, L4, L7), others are not (L1). Those who fall into the first category often turn to their mathematics teacher for help. Assistance mainly takes on the form of extra classes. During such sessions the teacher necessitates that learners pinpoint their own errors in their work, determine what exactly they struggle with and once attempts to do so have been made, they may approach her and request assistance. According to the teacher, some learners lack the necessary discipline to follow this process and expect her to do it for them *("Dit frustreer hulle as ek vir hulle sê ek is vanmiddag hier, maar ek gee nie klas nie, jy kom vra vir my iets, maar dit is vir hulle te veel moeite." [It frustrates them if I tell them I'm here this afternoon but I'm not giving class, you can come ask me something but it's too much effort for them.]* (T). However, she feels merely presenting extra lessons would be less beneficial to their personal development within the subject as it may not create the space within which learners can actively engage with the content they find particularly challenging (T).

Extra classes may also be sourced from entities other than the mathematics teacher. One learner indicated that she does *AdMaths* which is extra mathematics classes focused on higher-level calculations and setting learners up for successful mathematics related tertiary training (AdMaths, n.d.). The learner-participant was of the opinion that the difficulty level of the work covered in these classes is higher than that done in her grade 10 class at school. Therefore, although she found the *AdMaths* work challenging, especially initially, it helped her better deal with the work done in class mainly because she had had practice in doing work of a more complex nature (L7).

In contrast to those who actively seek assistance, some learners may not seek out help in instances when they need it. The main reason for neglecting to do so revolves around fear; fear that in the process of trying with the help of someone else they may still get the calculations wrong (L1). Another stated that she will only seek assistance on a portion of work she finds difficult if she knows she will be tested on that same content in a subsequent evaluation *("Ja, veral as jy weet jy gaan nog 'n toets daaroor skryf, maar ek sal nou nie so sê as jy nou weet dit is nou soos die laaste toets dan sal ek nou nie rêrig weer gaan nie.") [Yes, especially if you know you are going to write another test on it but I wouldn't say so if you know it's like the last test then I wouldn't really go back.]* (L7).

4.2.3.3 Guidance provided

The mathematics teacher, in addition to being sought out by learners for assistance, also offers additional forms of guidance and support other than those mentioned above. During class exercises and preparations for an evaluation she reminds the learners that they have done the work before *("… dan sê ek onthou jy het daardie deel gedoen …") [… then I remind them that they did that part …]* (T) and therefore should be able to manage in dealing with it during the actual evaluation. Within the class context she also points out errors in their work which enables them to continue in pursuit of the answer *("… ek sê maar hoor hier, jy het net daardie klein foutjie gemaak, kyk gou mooi daar is 'n fout … dan sien hulle hul eie foutjie en dan gaan hulle aan en dan is hulle vol moed weer.") [… I say but listen here, you only made that small mistake, look at it closely, there is a mistake … then they see their own mistake and continue; feeling encouraged again.]* (T). According to her, providing

learners with direction makes a big difference to their attempts at confronting mathematical problems.

Upon setting a test paper the mathematics teacher deems it necessary to start off with easier questions so that learners may experience a sense of mastery, which in turn encourages them to continue and keeps them from becoming despondent. She admits though that sometimes she neglects to do so *("Partykeer vergeet jy om die eerste som maklik te maak.") [Sometimes you forget to make the first sum easy.]* (T). Learner 9 is in agreement that this approach to questioning is helpful during an evaluation *("… as ek die toets voor my kry en ek kyk soos die eerste vraag en ek sien dit is heel maklik, ek kan dit doen dan raak, maak ek myself rustiger …") [… if I have the test in front of me and I see the first question and I see that it is easy, I can do it then I calm myself …]* (L9).

The teacher further reiterates that learners' engagement with mathematical problems is a process and reminds them to be patient with themselves and their dealings with the subject content. When assigning homework as practice for what is to be expected in an evaluation, she encourages learners to attempt to answer all the questions as opposed to giving up upon encountering the first one they struggle with *("… nou probeer ek vir hulle leer met huiswerk onthou as jy die eerste som nie kon gedoen het nie beteken dit nie die res moet jy los nie …") [… I remind them that when they are doing homework and cannot do the first sum that doesn't mean they should leave the rest …]* (T). Lastly, as postulated above, the mathematics teacher avails herself for extra classes and additional assistance outside of class time (T).

4.2.3.4 Study methods

Approaches to studying and the manners in which learners approach mathematical problems are important, especially when preparing for an evaluation. The mathematics teacher regards the following as essential parts of the preparation process: learners should remain focused and actively engaged with the material and distractions such as listening to music or conversing with friends should not form part of their working environment (T). Furthermore, learners should engage with the work on their own. This entails coming to the realisation that they need to decipher for themselves how to solve mathematical equations and this should rather not be done

as a group exercise (T). An illustration hereof is reflected in the following: *"… jy praat oor … die vraag … dan is jy besig om te leer, maar dit werk nie in wiskunde nie. Wiskunde moet jy op jou eie gaan sit … daar kan nie, dit is nie nou musiek, bring gou vir my koffie, alle sosiale goed nie, dit is vir afsny en hier moet jy alleen baklei hiermee …" [… you speak about … the question ... if you are busy studying but it doesn't work in mathematics. Mathematics you have to sit on your own … there cannot, it isn't music, bring me coffee, all social things; it is about cutting yourself off and you have to fight with it on your own.]* (T). Most importantly, learners need to remain engaged with the work and practice on a continuous basis (T). All these components the teacher deems necessary to effective preparation for an evaluation, learners often realise at a very late stage of their schooling careers *("… en daardie besef van dit is nou op my eie kom ook eers later. Ek het gister besef my graad 10's is nou daar; hulle is al amper in graad 11.") [… and that realisation of it's on my own now only comes later. I realised yesterday that my grade 10's are only there now and they are almost in grade 11.]* (T).

4.2.4 Achievement

Within this section, learners' achievements in mathematics as reflected in their exam marks, will be examined. Reports will be based on their final mathematics results for grades 8 and 9, as well as their mid-year grade 10 marks.

Overall, there has been a decline in learners' mathematics marks during the time period of grades 8 and 9, and midway through grade 10. Nevertheless, all the learners obtained a passing grade in the subject. A closer examination of the marks revealed more complex information which will henceforth be discussed.

Upon closer scrutiny it became clear that seven of the nine learner-participants' marks declined between grades 8 and 10 (L1, L2, L4, L6, L7, L8, L9). One of the two remaining learners' marks showed a steady increase from 50 to 60 percent over the two and a half year period (L5). He shared that, *"Ek stres baie. Dit is maar meestal die algebra waaroor ek stres, die meetkunde is okei." [I stress a lot. It's mostly algebra that I stress about, geometry is OK.]* (L5). When asked about factors that impact on his anxiety toward mathematics, he stated: *"… my ouers is streng." [My parents are strict.]* (L5). The totality of these factors causes him to stress a great deal

about evaluations in mathematics but it also spurs him on to try and achieve to his full potential. The other learner (L3) had continuously obtained marks in the low to mid 80 percentile range for mathematics since grade 8. According to her, she is someone who stresses a lot in general but who is comfortable in her understanding of mathematics and therefore enjoys the subject (L3). This is evidently reflected in her marks.

More in-depth exploration of learners' marks and their experiences of stress surrounding mathematics yielded interesting findings. Among the four learners with the highest marks (L2, L3, L7, L9), as obtained midway through their grade 10 year, two distinct patterns were identified. Firstly, half the learners who reported experiencing marked signs of stress and anxiety concerning evaluations in mathematics obtained good marks (L7, L9). Secondly, the other half who did well reported minor levels of stress pertaining to mathematic evaluations (L2, L3). A similar converse pattern was discerned among those learners in the group whose marks fell within the lower range of the entire group of learner-participants' marks. These learners either stress excessively about mathematics because they struggle with the subject, therefore do not attain particularly high marks (L1, L5, L6) or they show little concern about their achievement in the subject and therefore display minimal signs of distress over it (L4, L8).

In general, the group average in mathematics had remained within the 70s range despite a decline in overall achievement. As reflected in learners' midyear grade 10 marks, more than half the group (L1, L2, L3, L4, L7, L9) obtained an average of between 70 and 86 percent.

The mathematics teacher is of the opinion that anxiety causes blockages which hamper performance (T). Upon elaboration it became clear what she meant by this. Negative thoughts that learners may think of during the course of an evaluation could distract from their focus on the mathematical tasks at hand. This in turn may hinder their ability to perform optimally on an evaluation (T).

The teacher considers timeous feedback on marks of the utmost importance. The time laps between writing a test and receiving marks should be kept as short as possible. She provided the following rationale for holding this view, *"… dit is vir my*

ongelooflik belangrik om vir hulle die volgende dag te probeer daardie punte te gee dat hulle nog die emosie kan oproep … want ek sê vir hulle onthou hoe jy gevoel het toe jy geskryf het, hier is jou punt nou." [It is extremely important to give them their marks the next day so that they can still recall the emotion … I ask them to remember how they felt whilst writing when they see the mark they obtained.] (T). It is thus the intent of the teacher to make learners aware of possible connections between their feelings and the marks they obtained in the evaluation. She wants them to gain a realistic perspective on the connection between these two factors *("… ek het so geskryf en dis my punt.") [That is how I wrote and this is my mark.]* (T), so as to minimise the occurrence of the following: *"Jy't gedink jy het fantasties geskryf, maar jy het absoluut nonsens geskrywe." [You think you wrote a good paper but you wrote absolute nonsense.]* (T).

4.3 DISCUSSION OF RESEARCH FINDINGS

In figure 4.1 a depiction is provided of the factors that were found to influence learners' experiences and understandings of mathematics test anxiety. The discussion of the research findings will be in line with this representation.

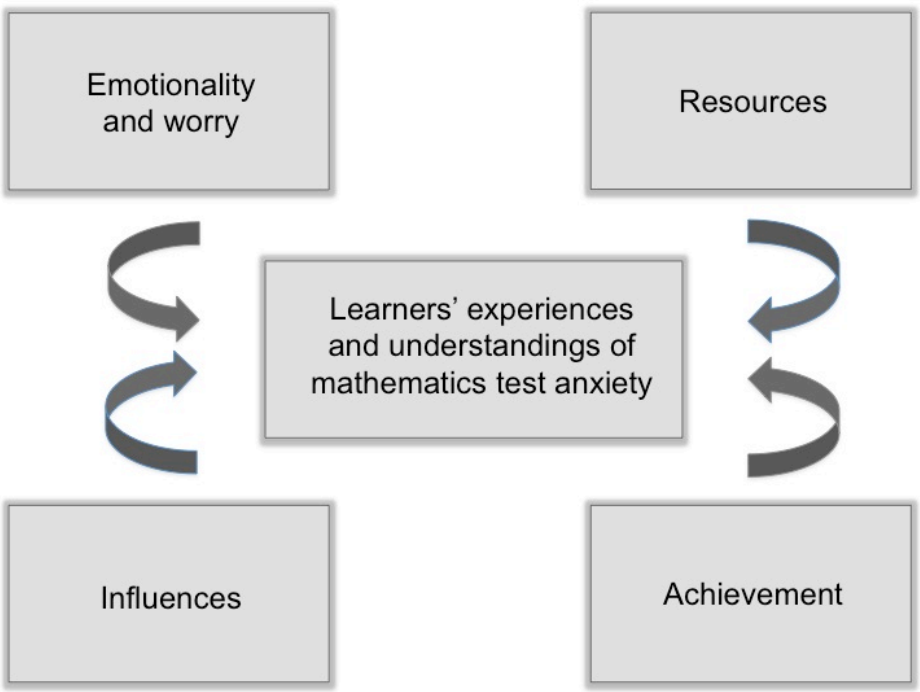

Figure 4.1: Factors that influence learners' experiences and understandings of mathematics test anxiety

4.3.1 Introduction to the discussion

The research process was guided by a social cognitive perspective as theoretical framework for the inquiry. The discussion of the research findings will thus be presented from this world view. The focus of this discussion will be on providing a conceptualisation of the research findings, while contextualising it in the existing literature on the phenomenon under exploration. Prior to embarking on such a discussion it is necessary to reiterate the initial intent of the inquiry.

The research study was primarily aimed at exploring a group of grade 10 learners' experiences and understandings of mathematics test anxiety. In addition hereto, the study focused on identifying factors which contribute to experiences of anxiety pertaining to evaluations in mathematics, as well as instances when anxiety does not influence such evaluative situations. I strived to not use the existing body of knowledge to verify or support the findings but instead to contextualise the findings within existing literature. In so doing, I aimed to respect participants' experiences and understandings as I consider it valuable information in adding depth to the existing literature on mathematics test anxiety.

A discussion of the research findings will be the focus of this section. The findings will further inform suggestions and recommendations for future studies in the field of mathematics anxiety. These and other concluding remarks will be presented in chapter 5.

4.3.2 Participants' experiences and understandings of mathematics test anxiety

Huberty (2009) states that all individuals experience anxiety, particularly when the outcome of an event is marked by uncertainty. Learner-participants gave clear indications of anxious feelings concerning evaluations in mathematics. They further noted feeling a sense of relief immediately following an evaluation in mathematics and hereafter anxiety is again felt in anticipation of the marks to be obtained. As such, learners' experiences are on par with Huberty's (2009) notions on anxiety and ambiguity concerning the outcome of an event.

Cassady and Johnson (2001) postulate that test anxiety encompasses two components, namely emotionality and worry. These translate into physiological – and cognitive effects, respectively. Participants put forth experiences such as an increased heart rate and sweaty palms, amongst others, which are consistent with the physiological responses documented in the works of various theorists (Deffenbacher; Hembree; Morris et al., as cited in Cassady & Johnson, 2001). In addition, cognitive reactions and internal dialogue, also termed self-talk, occur at various stages of the learning-testing cycle. The experiences learners shared, such as feeling inadequately prepared for tests, worries over disappointing their parents, and a lack of confidence in their own abilities are consistent with existing literature on the topic. In contrast to literature, learner-participants in this study did not report making comparisons between their own achievements and that of their peers (Deffenbacher; Hembree; Morris et al., as cited in Cassady & Johnson, 2001). Woolfolk (2010) states that focusing solely on one's own abilities by asking "Can I do it?" is revealing of high levels of self-efficacy. Thus, the learner-participants in this study appeared to be oriented towards themselves and their own knowledge on their ability to accomplish a particular task in a successful manner (Woolfolk, 2010).

The work of Cassady and Johnson (2001) further postulates that the cognitive component of test anxiety, i.e. worry, is interlinked with academic achievement and produces declines in learners' performance. The findings indicated that among learners who display significant signs of stress and anxiety about evaluations in mathematics, good marks are still obtained. Although these findings are contrary to existing literature, the mathematics teacher's reports are consistent with the notion that worry causes declines in performance. She highlighted that cognitive distractions experienced during an evaluation keep learners from performing optimally and by implication may cause them to underachieve, based on their individual ability. Learners might not be aware of this link between anxiety and performance which is why the teacher aims to provide swift feedback after an evaluation so that learners may still be able to recall how they felt during the evaluation and see its possible impact on their marks obtained.

In the discussion on cognitive test anxiety in chapter 1 it was postulated that three theories underpin this phenomenon, namely the cognitive model, the interference

model and the additive model of test anxiety. In accordance with the cognitive model, learner-participants reported experiencing worrying feelings about insufficient preparation for a test and the subsequent outcome of the evaluation. Reports were also made on the inability to subdue competing ruminations during an evaluation which is possibly related to poor performance. Again, no mention was made of comparing one's own abilities to that of others (Sarason, 1984; Schwarzer & Jerusalem, as cited in Cassady & Johnson, 2001). As postulated by the interference model, both learners and the teacher reported difficulties in restricting attention to the mathematical task at hand when experiencing high levels of test anxiety. There are, however, learners who are able to effectively focus their attention on the most relevant cues during an evaluation (Deffenbacher; Hembree; Morris et al., as cited in Cassady & Johnson, 2001). The additive model puts forth trait test anxiety and situation-specific variables as influential in learners' experiences of cognitive test anxiety (Zohar, 1998). In accordance, some learners indicated that their character trait, whether it's being inclined to worry or to remain calm, impact on their experiences pertaining to evaluations in mathematics. Therefore, findings are partially consistent with the cognitive model, entirely consistent with the interference model and in correspondence with the additive model of cognitive test anxiety.

The findings on the relationship between test anxiety and academic performance were not entirely negatively skewed, as postulated in the work of Zeidner (1998). Although this reflects the experiences of some of the learner-participants, others utilise anxiety in a positive manner to orientate themselves to do well. Positive orientations such as this can be used as a base from which meaningful learning strategies, as proposed in the work of Reed and Warner-Rogers (2009), can be implemented as a means of offering assistance from an educational and psychological framework. The guidance and proposed study methods mentioned by the mathematics teacher can also be incorporated within such strategies.

In essence, the findings of this study are in agreement with the works of various theorists (Cassady & Johnson, 2001; Morris et al., 1981) which postulate that the cognitive domain of test anxiety has a profound impact on learners' academic achievement. Therefore, it can be inferred that by engaging in realistic, adaptive and abstract ways of thinking that are aligned with the adolescent cognitive

developmental stage; learners may be able to reduce and ultimately change dysfunctional thinking. This in turn is likely to have a positive effect on both the emotional state and behaviour patterns of learners (Beck, 2011; Donald et al., 2014). A positive affect and accompanying actions will almost certainly be beneficial to learners across all phases of the learning-testing cycle. Similarly, learners' emotions, behaviour and physiology impact on their cognitions surrounding evaluative situations in mathematics. Therefore, by altering cognitions in adaptive ways, learners may experience a decrease in anxiety pertaining to evaluations in mathematics (Beck, 2011; Charnery & Drevets, 2002; Etkin, 2009). The preceding argument accentuates the causal connection between thoughts, actions and emotions as postulated by Beck's (2011) cognitive model, thereby highlighting the pivotal role hereof as part of the theoretical framework of this study.

At the onset of the study, it was postulated that conceptualisations of human behaviour necessitate an examination of experiences and understandings within an interactional perspective (Bandura, 1986). Accordingly, focus will now shift to factors other than cognitions which impact on individual experiences. The interchange between the three influences of the triarchic reciprocal causality system as evident in social (environmental), self (personal), and achievement outcomes (behavioural) are discernable in learners' experiences and understandings of mathematics test anxiety.

Social (environmental) influences are concerned with the roles of significant others and discourses in the public domain. These serve as models that impact on learners' ideas and behaviour (Woolfolk, 2010). Findings indicated that friends have a predominantly positive, encouraging effect on one another, whereas parents' actions either support or serve to add to their child's experience of anxiety about mathematics evaluations. The mathematics teacher aims to be a constructive entity for learners by assisting them in gaining a better understanding of mathematics, as well as attempting to motivate the learners so as to minimise the effects of anxiety during evaluations. The media, in light of the teacher's views, overemphasise the importance of mathematics which in turn causes parents and learners to experience unnecessary anxiety about the subject. The meanings learners give mathematics is thus embedded in their social context as it stems from cultural sources of knowing (Woolfolk, 2007). This notion is reminiscent of Vygotsky's theory of social

constructivism which postulates that meaning is constructed through social interaction with relevant sources of social influence (Burr, 2003). Findings indicated that learners attribute meanings of value and necessity to mathematics as subject. As such, it can be argued that this judgement made by learners may stem from both parental and media influences.

Self (personal) factors are centred on an individual's sense of self-efficacy (Woolfolk, 2010). Learners gave indications that being well prepared, having a good understanding of the work and others' displays of belief in their abilities, act as motivation and increase their sense of self-efficacy. Therefore, learners feel they are better able to engage with the content in a mathematics test and arise victorious. Furthermore, biological influences also impact on learners' experiences of anxiety. Based on their personalities and characters, some learners manage to remain calm under seemingly stressful situations while others display marked signs of anxiety concerning evaluations in mathematics. Furthermore, biological influences, as encompassed in personality and character also influence learners' experiences of anxiety. While some are naturally more inclined to remain calm under seemingly stressful situations, others do display marked signs of anxiety about evaluations in mathematics. The experience of panic attacks is seemingly more likely to occur among learners in the latter group.

Achievement outcomes (behaviour) are most closely associated with motivation. Woolfolk (2010) states that motivation is either sourced from within individuals themselves or from external sources. Confirmations on both sources of motivation were found. Indications were given that some learners are intrinsically motivated based on personal goals they aim to reach. By contrast, there are learners who value encouragement and displays of belief in their abilities offered by significant others as influential in decreasing their experience of anxiety surrounding evaluations in mathematics. As such, motivation serves as an academic enabler (Linnenbrink & Pintrich, 2002), influential in learners' experiences of mathematics anxiety (Hlalele, 2012).

The mathematics teacher shared certain understandings of and observations made concerning learners' engagement with mathematics which resembles the various influences of the triarchic reciprocal causality system. Firstly, she reported that some

learners lack the necessary work ethic to fully engage with mathematical equations in an effort to reach the appropriate outcomes. Secondly, these learners are more inclined to seek assistance from her, as their mathematics teacher, as opposed to finding the mistakes in their calculations independently. Thirdly, it is deemed by the mathematics teacher that many learners never acquired the necessary skills to master the increasing difficulty levels in subject content, especially when progressing from grade 9 to grade 10.

Through these accounts it becomes evident that not all grade 10 learners doing mathematics have mastered metacognitive thinking skills. While some learners may be aware of their own thought processes, particularly in terms of how they think, plan, problem-solve and remember information whilst engaged with mathematical tasks, others may not have the same cognitive awareness. By being cognisant of what one does and why, one is potentially able to critically evaluate and adapt the strategies one utilises when engaged with mathematics (Donald et al., 2014).

The use of symbols such as language and mathematics to represent the real world means that individuals develop their representations hereof gradually (Bruner, as cited in Donald et al., 2014) by progressively altering the manners of organising and portraying the world (Piaget, as cited in Donald et al., 2014). In this way the skills necessary to internally represent the world is learnt over time which in turn assists learners in engaging with cognitive activities such as thinking about their own thinking and problem-solving. In due course these logical patterns of thinking will develop and manifest as core components of metacognition (Donald et al., 2014). Given the theoretical underpinnings of metacognition, it may be deduced that some learners have yet to acquire these skills and that it may be obtained by adapting the pedagogical approaches employed in the classroom so as to accommodate for different ways of thinking and learning (Neuman & Roskos, 1997; Perry, 1998; Wharton-McDonald et al., 1997; Woolfolk, Perry & Winne, 2006; Zimmerman, 2002). This leads to an exploration of self-regulated learning, as postulated in the writings of Woolfolk (2010).

An essential part of teaching should be to guide learners toward being self-regulated. This is done by decreasing the need for teachers and encouraging learners to learn independently in a continuous manner throughout their lives (Woolfolk, 2010). In

order for self-regulation to be actualised in learners, they need to have knowledge, motivation and self-discipline. Knowledge about oneself regarding personal strategies for learning, as well as a thorough understanding of the subject content and the context in which learning will be applied, will inform which strategy to use given the learning task at hand. In addition to knowledge, motivation is a key influence in self-regulation. As stated by numerous learner-participants, being orientated towards achieving certain goals in the future, serves as a motivating factor in the present and acts as the reason why they study. Therefore, the actions and choices of these learners are internally motivated and controlled by themselves (Woolfolk, 2010). In combination with knowledge and motivation, self-regulation also requires self-discipline. Accordingly, learners need to protect themselves from factors such as distractions in their study environment and anxious feelings which may detract from them reaching their goals (Woolfolk, 2010). In earlier discussions, reference was made to how distractive factors manifest and influence the experiences of learner-participants, as well as learners in general.

Teachers can assist learners in developing skills for independent, self-regulated learning by making certain accommodations to how classroom interactions and tasks are structured (Neuman & Roskos, 1997; Perry, 1998; Wharton-McDonald et al., 1997; Woolfolk, Perry & Winne, 2006; Zimmerman, 2002), thereby allowing for the adolescent cognitive developmental task of abstract thinking to occur (Donald et al., 2014). Academically effective forms of self-regulated learning and an accompanying sense of efficacy for learning is developed when the following elements are incorporated in the teaching-learning process: complex meaningful tasks, control, self-evaluation and collaboration (Woolfolk, 2010).

The role of the teacher is thus to emphasise progressive potential by assigning tasks that challenge learners without being too difficult and that may result in the experience of frustration (Donald et al., 2014; Rohrkemper & Corno, 1988; Turner, 1997). In addition hereto, learners should be allowed to exercise a degree of control over their own learning. This can be achieved by permitting learners to make certain choices concerning the manner in which to produce the desired outcome of a specific task and whom to work with during such an endeavour. The latter also signifies collaboration between peers. This process of entrusting a degree of control to

learners should be guided by the teacher through modelling good decision making, tailoring the choices provided to learners so as to accommodate for the unique characteristics of each individual, and by providing learners with feedback regarding their choices (Woolfolk, 2010). When learners feel in control of their own learning, they hold a higher expectation of success which in turn leads to an increase in efforts made and perseverance shown (Turner & Paris, 1995). Furthermore, learners should be allowed to monitor and evaluate their own work progress. The teacher can do this by involving learners when setting the criteria for evaluations and by giving them the opportunity to make judgements about their progress using the jointly set evaluation criteria (Woolfolk, 2010). As is evident, these teaching-learning interactions are marked by complex meaningful tasks, control, self-evaluation, and collaboration among peers as well as between learners and their teacher (Woolfolk, 2010).

The aforementioned arguments on metacognition and self-regulation served to illustrate how the mathematics teacher in this study may alter her pedagogical approaches in order to effectively accommodate the varied needs of the learners in her classroom. In addition, it clarifies that what she deemed to be a lack of work ethic, failure to work independently and a deficit in skills necessary to handle changes in the complexities of the subject content between grades, may in fact be the presentations of a deficit in metacognition and self-regulation. Both these skill sets may be learnt, provided certain accommodations are made to the teaching-learning processes used (Neuman & Roskos, 1997; Perry, 1998; Wharton-McDonald et al., 1997; Woolfolk, Perry & Winne, 2006; Zimmerman, 2002).

The three influences of the triarchic reciprocal causality system serve as reflections of the main principles of social cognitive theory (Bandura, 1977; 1986; Bandura; Bandura & Kupers; Bandura & Mischel; Bandura & Whalen; Muuss, as cited in Malone, 2002), as experienced by the learner-participants and witnessed by their mathematics teacher. The experiences and understandings pertaining to learners' approaches to mathematical tasks, as shared by their mathematics teacher, further portrayed the manners in which social, personal and behavioural influences manifest with regards to mathematics and how these may be addressed within the classroom. In turn, the three influences of the reciprocal causality system can be connected to the three phases of the learning-testing cycle. Data collected are indicative of

learners having various experiences during the preparation, performance, and reflection phases pertaining to evaluations in mathematics. An exploration hereof aims to shed light on the importance of thoughts and patterns of behaviour pertaining to test anxiety (Cassady, 2004).

4.3.3 Participants' experiences during the test preparation phase

The mathematics teacher elaborated on what she deemed to be ineffective approaches employed by some learners when preparing for an evaluation. Judgements made about the ineffectiveness of some learners' preparation are based on the personal opinions and views of the teacher. From statements made, she appeared to be largely orientated toward the direct instructional method (Donald et al., 2014) which views learning as a process of acquisition whereby learners are regarded as empty containers to be filled with skills and knowledge by teachers (Kozulin, Gindis, Ageyev & Miller, 2003). This traditional model of learning thus conceives of learners as passive recipients of pre-packaged knowledge (Kozulin et al., 2003) and is in direct contrast to constructivist views of learning which forms an integral part of the literary foundation of this study.

A constructivist view of learning holds that learners are active participants in the process of knowledge construction and that social interaction is central hereto (Bruning, Schraw, Norby & Ronning, 2004). In his work on social constructivism, Vygotsky deemed activity, social interaction and cultural tools necessary components to individual development and learning. As such, learning forms part of the social and cultural context of individuals (Donald et al., 2014; Paris, Byrners & Paris, 2001). Classrooms are considered to be a complex cognitive environment wherein each individual learner possesses a set of skills, abilities, knowledge and experience. Herein lays the opportunity to share these attributes amongst each other through assimilation and accommodation of information (Donald et al., 2014) so as to add breadth and depth to understanding (Hardman, 2004). The development of an individual's higher mental processes and more speciafically abstract thinking, as characteristic of the formal operational stage of adolescents, are dependent upon interaction with mediating agents in the environment (Bandura, 1986; Donald et al., 2014; Kozulin et al., 2003). Mediating agents can take on different forms. Teachers and peers may act as human mediating agents while symbols, formulae and signs

act as symbolic mediating agents. Whether human or symbolic, mediating agents assist learners in internalising information and mastering certain skills (Kozulin et al., 2003).

Through active engagement in educationally oriented activities, learners are able to help each other in constructing knowledge and resources (Hardman, 2004; Paris et al., 2001), as well as internalise the outcomes which were produced by working collaboratively on a task (Paris et al., 2001). The movement between individual performance before and after learning or assistance, also deemed the difference between an individual's actual performance and learning potential, is referred to as the zone of proximal development (ZPD) and it is within this space that scaffolding takes place (Kozulin et al., 2003).

All educational activities should be directed towards a physical or mental product, also termed an object, that in some ways are altered through the use of certain tools. These tools are culture specific and influence individuals' thoughts and actions which in turn are aimed at accomplishing certain goals (Hardman, 2007). The outcomes of such educationally oriented activities could comprise of new strategies which not all individual members of the group had previously appropriated but now had internalised (Paris et al., 2001). This process of mediation is illustrative of individuals' vicarious capability to acquire knowledge through modelling which is possible when collaboration occurs between an adult or peers who have already acquired the cognitive tools that enable knowledge construction and those who have yet to appropriate these tools (Bandura, 1986; Donald et al., 2014), thereby allowing for scaffolding to occur as an individual is able to solve a problem in terms of higher cognitive functions with assistance from another (Woolfolk, 2007). During this process the questions and responses raised by learners create the space within which their peers are potentially able to draw on a rich learning resource (Hardman, 2004). This serves to demonstrate that learners' abilities to appropriate their peers' responses into their own methods of solving equations suggests that the exchange of knowledge through social interactions has potential as both a cultural and learning resource (Hardman, 2004).

As knowledge acquisition is both socially mediated and individually constructed (Woolfolk, 2007), it can be deduced that distractive elements such as those

mentioned by the mathematics teacher are not necessarily entirely negative in the effect they have nor truly distractive. According to the skills-deficiency model distractive elements may interfere in learners' cognitive processing ability which in turn could result in underperformance and heightened levels of test anxiety, especially when the study methods employed are repetitive and less effective (Cassady, 2004; Naveh-Benjamin, 1991). The issue is thus not the amount of studying done but rather the methods employed during the preparation process. This notion is in line with the mathematics teacher's report that some learners think they are well prepared based on the number of hours spent with their books, unaware that such engagements may not have been particularly productive. However, when test preparation methods are grounded in an active process of knowledge construction, a social component hereto may be beneficial (Woolfolk, 2007). Imperative to such an approach is that engagement emphasises skilful, agentive and explorative performance as these elements resemble a more productive path to learning and is more likely to yield a positive identity in mathematics (Heyd-Metzuyanim, 2013; Mulligan, 2011).

Engaging with their peers in problem solving is thus likely to assist learners in developing mathematical skills (Woolfolk, 2007), especially since a learner is able to find suitable vocabulary and examples with which to explain concepts to their peers, possibly better than a teacher, once they themselves have an understanding thereof (Hardman, 2004). The interactional processes learners often participate in are imperative to gaining a better understanding of the subject content. This is achieved by assisting learners to make connections between that which is familiar and that which they do not yet fully understand by employing their potential and using higher cognitive functions to reach the so-called unfamiliar. This mediated process from the familiar to the previously unfamiliar occurs within the ZPD (Woolfolk, 2007). This theoretically based argument serves to illustrate that although there is room for the teacher's 'banking' approach to teaching whereby knowledge is given (Freire, as cited in Woolfolk, 2007), a social constructivist approach which advocates for the active and continuous construction and reconstruction of knowledge by individuals and groups is also imperative to knowledge acquisition (Woolfolk, 2007).

The works of various theorists (Covington, 1992; Winne & Jamieson-Noel, 2002; McGregor & Elliot, 2002; Cassady & Johnson, 2002; Wolters, 2003) postulate that in instances when learners regard their own abilities and skills as insufficient to effectively engage with the content of the test and achieve success, these notions manifest as a decrease in self-efficacy. Findings indicated that less than optimal study conditions culminate into negative emotions about evaluations in mathematics (Covington, as cited in Cassady, 2004; Elliot & McGregor, 1999; Schutz & Davis, 2000; Schutz, Davis & Schwanenflugel, 2002) which in turn may result in poor performance (Cassady, 2004). By contrast, learner reports were made of feeling calm when having prepared sufficiently for an evaluation. According to literature by Birenbaum and Pinku (1997), as well as Naveh-Benjamin (1991) this feeling results from adequately encoding and organising information during the preparation phase prior to an evaluation, provided studying took place under optimal conditions.

4.3.4 Participants' experiences during the test performance phase

Consistent with the work of Covington and Omelich (1987) are learners' reports of going blank or failing to retrieve information during an evaluation in mathematics despite having employed what they deem to be effective study skills. Furthermore, distracting thoughts also cause interference in the test taking process, which is consistent with existing literature (Cassady & Johnson, 2002; Sarason, 1986; Schwarzer & Jerusalem, 1992). Another factor that impacts on learners' experiences during the test performance phase is initial judgements made regarding the difficulty level of the test. In accordance with previous studies done by Zeidner (1998) are learners' reports that an easier question at the onset of a test assists in building confidence about one's ability to attempt the rest of the questions. Closely related is the mathematics teacher's notion that the first problem on a test should be easy to solve which in turn corresponds with one learner-participant's statement that mastering the first question in a mathematics evaluation enables him to remain calm and approach the rest of the questions with confidence. Whilst successes raise efficacy beliefs, failures tend to have the opposite effect (Woolfolk, 2010). It can thus be deduced that the experience of success on the first question of an evaluation raises efficacy thereby providing the individual with a sense of knowing that they have the ability to accomplish similar successes on subsequent questions. As a

direct individual experience, mastery contributes to a sense of self-efficacy by illustrating to the individual that they have the ability to successfully solve a problem. This process thus serves as a powerful source of efficacy information (Woolfolk, 2010).

Findings concerning the difficulty levels of items on a test necessitate an exploration of its impact on learners' experiences of anxiety during an evaluation. Although such research was not done during the initial literature review, the findings necessitated that such an exploration be done. As the researcher I acknowledge this need and will address it here.

Bloom's Taxonomy was created in the 1950s by Benjamin Bloom (1956). It offers a method to categorise the levels of reasoning skills necessary in classroom situations. In total, six different levels of reasoning skills exist, each necessitating a higher level of abstraction from learners. The task of the teacher is to assist learners to progress along these levels in an upward trend (Bloom, 1956). As this method is applicable to tasks done in the classroom context, if follows that it be incorporated in evaluative situations as well. This in turn resonates with Zeidner's (1998) work on the difficulty of test content. Both learner and teacher reports on the matter thus relate with existing literature.

4.3.5 Participants' experiences during the test reflection phase

Negative experiences concerning the obtainment of unsatisfactory marks often become internalised, causing learners to attribute failure to lacking abilities (Elliot & McGregor, 1999). The mathematics teacher made reference hereto in stating that learners who find the subject content particularly challenging may become despondent and neglect to make significant attempts at mastering the work. They no longer view the subject as challenging but rather become debilitated by it. The mathematics teacher, in accordance with a previous study (Schwarzer & Jerusalem, 1992), proposed that this in turn leads to failure.

By contrast, when engagement with the subject content follows a productive path, a positive outcome is highly probable (Heyd-Metzuyanim, 2013; Mulligan, 2011). This in turn may yield performance successes with accompanying high levels of self-efficacy (Bandura, 1997). Notions such as these are on par with learner reports of

feeling predominantly calm following an evaluation in mathematics due to sufficient effort having been made during the preparation phase or because of an enjoyment of the subject based on a thorough understanding of the content and possible prior successes experienced during evaluations.

4.4 SUMMARY OF CHAPTER

From data analysis, rich and detailed descriptions of learners' experiences and understandings of mathematics test anxiety were gained. Both learners and their mathematics teacher provided accounts of factors that contribute to the experiences of anxiety related to evaluations in mathematics. In addition, clear indications were given of circumstances that act as barriers against the experience of anxiety related to evaluations in mathematics. Hereby, clarity was gained on the research questions posed at the onset on this inquiry.

This chapter further aimed to connect research findings with existing literature in an attempt at providing a clear understanding of the phenomenon under inquiry. In instances when the theoretical underpinnings portrayed in the literature review did not suffice in providing an adequate foundation within which to locate current findings, the theoretical foundation of the inquiry was elaborated upon.

Chapter 5 will present concluding remarks on the research findings in answer to the research questions and put forth recommendations that arose from the research process. The strengths and limitations of the study, as well as suggestions for future research and concluding reflections will also be included in the discussion.

CHAPTER 5

CONCLUDING REMARKS, RECOMMENDATIONS, LIMITATIONS AND STRENGHTS

5.1 INTRODUCTION

This study aimed to explore the phenomenon of test anxiety within the subject of mathematics as experienced by grade 10 learners and observed by their mathematics teacher. The inquiry was motivated by the work of Sarason (1961) which postulates that anxiety interferes with evaluative situations, as well as findings from the work of Zeidner (1998) that proposes the existence of an association between anxiety and lower academic performance. In addition to these academically oriented motivational factors, a personal interest into the dynamics surrounding mathematics test anxiety, as experienced by myself during high school, further contributed to the chosen inquiry. The impetus for an exploration of test anxiety pertaining to mathematics was thus dual informed.

In particular, the study set out to investigate learners' experiences and understandings of mathematics test anxiety; the factors that might contribute to the experience of anxiety related to evaluations in mathematics; and the conditions under which anxiety does not influence evaluations in mathematics. Based on the works of various authors (Cassady & Johnson, 2002; Morris et al., 1981) on the relationship between test anxiety and academic performance, it seems evident that the cognitive domain of test anxiety has a profound influence on academic achievement. The emphasis on cognitions concerning learning, test taking and achievement, lead to the choice of utilising social cognitive theory as a framework to guide and explain the intricacies of the research (Woolfolk, 2010).

Thus, a qualitative study, positioned within an interpretive paradigm and a theoretical framework of social cognitive theory, was used to attempt to answer the research questions as a means of realising the aims of the study. This was achieved by conducting individual interviews with a group of grade 10 learners taking

mathematics, as well as their mathematics teacher, the head of the mathematics department at the school. In addition hereto, learners' mathematics exam results as obtained over a two and a half year period dating back to grade 8 were collected, examined and incorporated into the research findings. Lastly, a creative group exercise of the drawing of the feelings prior to a mathematics test was done as a means of externalising the problem to some extent. In its totality, these components constituted the data which informed the research findings. All the participants were situated at a specific high school in the Western Cape. In accordance, every aspect of the data collection process occurred within this particular school setting.

The main focus of this chapter is on providing concluding remarks on the research findings. In addition, recommendations will be made that may assist in addressing the dynamics of mathematics test anxiety. The recommendations will be tailored to the needs and experiences of learners and teachers, in the distinct manners in which they are affected by it. Hereafter, the strengths and limitations of the study will be discussed. Suggestions for further research possibilities will also be made. The chapter will conclude with a personal reflection on the research process.

5.2 CONCLUDING REMARKS ON THE FINDINGS

Education is confronted with many challenges concerning the enhancement of teaching and learning (Spaull, 2013). Within the South African context specifically, a crisis exists in mathematics education (Adler, Brombacher & Shan, 2000) and many learners experience, to varying degrees, anxiety surrounding mathematics (Rossnan, 2006). When considered in its totality, these factors are indicative of a need to develop learners into conscious, effective and independent thinkers resulting from improved teaching and learning practices (Department of Education, 2002).

Against this background, the study hoped to make a meaningful contribution to the understandings of test anxiety as it manifests in the subject of mathematics and provide possible ways in which its occurrence may be addressed and ultimately decreased. The degree to which this endeavour served to answer the research questions postulated at the onset and the meanings derived from it upon concluding data analysis will henceforth be discussed.

Interpretation of the research findings indicated that the guiding components of grade 10 learners' experiences and understandings of mathematics test anxiety are emotionality and worry. These translate into physiological and cognitive components, respectively. On a physiological level, the experience of anxiety related to evaluations in mathematics may manifest in the form of bodily sensations felt. In addition, the emotional experiences of learners included anxiety, stress, frustration, anger, calmness and relief. Further components of emotionality are connected to cognitions. Thought processes, both constructive and less helpful in nature, directly influence learners' orientations toward and experiences of evaluative situations in mathematics.

Research findings also revealed that factors related to a general lack of understanding of the subject content resulting from factors pertaining to inadequate preparation by learners or ineffective teaching strategies; time constraints during the preparation and/or performance phases of the learning-testing cycle; expectations and pressures experienced; the perceptions and influences of others; as well as approaches to the work and evaluative situations are all influential in learners' experiences of mathematics test anxiety. Evidently, many factors might contribute to learners' experiences of anxiety related to evaluations in mathematics. Whilst these factors are not regarded as an exhaustive list of influences that may lead to the experience of mathematics test anxiety, it is representative of the most dominant domains addressed by participants.

The research findings had shown that various factors may be influential in protecting learners from experiencing anxiety relating to evaluations in mathematics, thereby acting as resources or assets. These take on the form of a thorough understanding of the work; guidance and assistance received from others; a sense of motivation and a high level of self-efficacy; as well as employing effective study methods. Whilst these factors do not guard against the experience of anxiety under all circumstances nor for all learners, it does serve as protective resources under certain conditions and for some learners. As such, it can potentially assist learners in reaching higher levels of achievement in mathematics and therein lays its value.

From a social cognitive perspective, where behaviour and thoughts are closely interrelated, I have interpreted the experiences and understandings that are

associated with mathematics test anxiety. The aforementioned concluding remarks provided a summary of the manners in which the research aims were met. In conclusion, the research questions were answered through descriptions of participants' subjective reasons, meanings, experiences and understandings of test anxiety pertaining to mathematics.

5.3 RECOMMENDATIONS

Reed and Warner-Rogers (2009) postulates that by distinguishing test anxiety from other forms of anxiety, specific assistance as deemed from an educational and psychological framework may be provided for dealing with its occurrence. At the onset of this inquiry it was stated that the study will endeavour to source ways in which the aforementioned may be materialised. Efforts to do so will be through the provision of certain recommendations for both learners and teachers to be utilised in their engagement with the dynamics surrounding evaluations in mathematics. In essence, all recommendations will be based on relevant information derived from the research findings thereby adding a degree of authenticity to its value as it is based on real-life experiences.

5.3.1 Recommendations for learners in mathematics

Utilise the individual skills, abilities, experience and knowledge of each learner in the class by sharing these qualities through a collaborative work approach. Through this shared meaning making process learners may assist one another in gaining a more thorough understanding of the subject content. This may further assist learners to internalise the information and to retrieve it at a later stage when working independently. In addition, engagement with peers aimed as collaborative problem solving may assist in developing mathematical skills which in turn positively influence the development of metacognitive skills and levels of self-efficacy. The application of cooperative learning opportunities might positively facilitate the above-mentioned skills development.

When moving beyond the classroom context to the study environment, preparation for an evaluation should take place within a calm and positive environment that is conducive to learning. Preparation should furthermore be oriented towards an

adequate understanding of the work. This may be brought about by engaging in a collaborative work approach with peers, as well as utilising the guiding information provided by the teacher with regards to comprehending the subject content so as to assist in each individual learner's meaning making processes. Following an evaluation, learners may benefit from having a space within which to debrief by discussing their experiences with peers and also their teacher. This might provide an opportunity to adjust and correct inadequate understandings.

Overall, it is imperative that learners determine their driving force of motivation. By being cognisant hereof, learners may draw on it in challenging times so as to have a driving force for perseverance. In addition, being equipped with stress and time management skills may be beneficial in coping with the potentially anxiety provoking factors surrounding mathematics.

5.3.2 Recommendations for mathematics teachers

Employing adaptive teaching techniques and pedagogical approaches may assist mathematics teachers in lessening the degree of anxiety pertaining to evaluations in mathematics as experienced by learners. Incorporating different ways of thinking and learning into the classroom environment will facilitate learners' development of metacognitive skills necessary for effective engagement with the work. These skills may also be utilised beyond the borders of the classroom.

Structuring the classroom environment so that learners of varying degrees of competence with regards to the subject matter are able to work collaboratively may create the space within which peer assistance can take place through the social construction of meaning. Within this context the teacher can flexibly move between the groups and provide guidance tailored to learners' micro-level needs. Hereby, learners will receive assistance from their teacher and support from their peers whilst being guided to work independently.

Through observation and engagement the teacher can potentially identify learners who may be experiencing heightened levels of anxiety surrounding evaluative situations in mathematics. In so doing, assistance may be provided to address the individual needs of the learner. In addition, the mathematics teacher could potentially have a significant effect on learners' orientation toward to subject. By assuming an

encouraging and supportive role, the teacher can serve as a constructive entity amongst the dynamics learners encounter in the subject.

5.4 LIMITATIONS OF THE STUDY

Qualitative research is characterised by a small sample size and in accordance the scope of the study was relatively narrow, due to the size of the sample. Broadening the sample would have increased the potential to generalise the research findings.

A methodological aspect that may be viewed as having limited the research is related to the mathematics results obtained. During data collection, only learners' examination results in mathematics were gathered. The complexities of the relationship between anxiety and performance may have been further nuanced had test results for the same time period been obtained. This may also have paved the way to compare performance under test and exam conditions respectively. Furthermore, the examination results were obtained as the final step in the data collection process. Had this been done prior to commencing with the interview process, it may have informed questioning.

The conceptualisation of knowledge and experience of general test taking anxiety was awarded brief exploration during the interview process. Conceptualisations of anxiety pertaining to evaluative situations and the manners in which such experiences may differ with regards to mathematics and other subjects could have been explored in more detail. The interview schedule for learner-participants did address general test anxiety as opposed to mathematics test anxiety; however, the difference between the two types of experiences could have been explored in more depth. Focus could have been placed on thought processes as well as on the answers (products). In mathematics the emphasis may be on either right or wrong answers or products which may contribute to the experience of anxiety while in other subjects, the process might carry more weight, and therefore similar experiences of anxiety may not be generated.

5.5 STRENGTHS OF THE STUDY

As a social research inquiry, the study was strengthened in exploring a human experience from an insider perspective. Employing a basic qualitative research

design utilising individual semi-structured interviews allowed both the learners and their mathematics teacher to share detailed descriptions of their experiences, understandings and observations of mathematics test anxiety. Furthermore, allowing learners to draw the feelings they experience prior to an evaluation in mathematics upon concluding the interview process, proved to be rather meaningful. It created the opportunity for learners to debrief, share information and to some degree externalise the experiences they have had so as to better deal with it in future. The collaborative approach in knowledge construction which transpired throughout the data collection process was indicative of the respect awarded to the autonomy and dignity of each participant.

A further strength of the study was that data collection took place during a naturally occurring test period as part of the school term. During this time learners, on a daily basis, wrote tests in all their subjects, including mathematics. This meant that the experiences learners shared were vivid which in turn lend a higher degree of authenticity to their statements.

Unexpected findings of the study accentuated gaps in the initial literature review. However, by recognising the importance hereof, the researcher aimed to accommodate for these findings by incorporating additional theoretical elements into the conceptualisation of the research phenomenon. Hence, although conceived as an initial limitation, the study used the unforeseen outcomes to add depth to the analysis.

5.6 FUTURE RESEARCH POSSIBILITIES

The suggestions made for future inquiries are centred on providing learners with support. Accordingly, that which will be put forth is concerned with factors considered necessary to effectively support learners in dealing with the emotions accompanying mathematics.

It emerged from the research findings that there is a need for an inquiry into the coping skills required for the effective management of anxiety surrounding evaluations in mathematics. A specific focus could be placed on dealing with such

emotions during the preparation, performance, and reflection phases of the learning-testing cycle.

Furthermore, the study highlighted a need to research the pedagogical approaches that would be deemed effective in a mathematics classroom, more specifically, employing a social constructive approach. Such an endeavour to meaning making may be explored from both the teacher's and the learners' perspectives. In addition, an exploration into the manners in which cooperative learning opportunities may be utilised so as to facilitate the development of an in-depth understanding of mathematics; the internalisation and retrieval of information; as well as the acquisition of mathematical skills, metacognition, and heightened levels of self-efficacy are postulated as focus areas for future research.

5.7 CONCLUDING REFLECTIONS

I wish to share my personal reflections on the research process as a whole and in particular the meaning I drew from it with you, the reader.

In the opening pages of this thesis I shared my underlying personal interest into the intricacies surrounding anxiety in test situations pertaining to mathematics. I made it known that my own struggles with mathematics during high school and consequent anxiety during evaluations in the subject partly motivated me to launch an inquiry into this phenomenon. This research process has served to shed light on something that has been a mystery to me for many years.

I have gained insight into the power of my own cognitions. In retrospect I am able to see how interfering ruminations kept me from staying focused on the mathematical tasks at hand and how negative self-talk lowered my sense of self-efficacy. Ultimately, these factors culminated into an intense opposition toward mathematics and consequently resulted in poor achievement in the subject.

As much as I have enjoyed this academic inquiry for the contribution I am able to make through it to existing literature, I have also gained personal insight along this journey of discovery and for that I am grateful.

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ADDENDUM A

LETTER OF ETHICAL CLEARANCE FROM STELLENBOSCH UNIVERSITY

UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot • your knowledge partner

Approval Notice
Stipulated documents/requirements

04-Aug-2014
Wyngaard, Timara T

Proposal #: HS1056/2014
Title: Exploring grade 10 learners' mathematics test anxiety.

Dear Ms Timara Wyngaard,

Your **Stipulated documents/requirements** received on **01-Aug-2014,** was reviewed by members of the **Research Ethics Committee: Human Research (Humanities)** via Expedited review procedures on **04-Aug-2014** and was approved.
Sincerely,

Clarissa Graham
REC Coordinator
Research Ethics Committee: Human Research (Humanities)

ADDENDUM B

LETTER OF ETHICAL CLEARANCE FROM THE WESTERN CAPE EDUCATION DEPARTMENT

Directorate: Research

Audrey.wyngaard@westerncape.gov.za
tel: +27 021 467 9272
Fax: 0865902282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 20140701-32201
ENQUIRIES: Dr A T Wyngaard

Ms Timara Wyngaard
79 Buitekant Street
Bredasdorp
7280

Dear Ms Timara Wyngaard

RESEARCH PROPOSAL: EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **22 July 2014 till 30 September 2014**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Dr A.T Wyngaard at the contact numbers above quoting the reference number?
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

    The Director: Research Services
    Western Cape Education Department
    Private Bag X9114
    CAPE TOWN
    8000

We wish you success in your research.

Kind regards.
Signed: Dr Audrey T Wyngaard
Directorate: Research
DATE: 01 July 2014

ADDENDUM C

LETTER OF SCHOOL CONSENT AS A RESEARCH SETTING

LETTER OF SCHOOL CONSENT AS A RESEARCH SETTING

To whom it may concern

REQUEST TO CONDUCT RESEARCH: MASTERS IN EDUCATIONAL PSYCHOLOGY RESEARCH STUDY

I hereby request permission to conduct a research study at your school. The study intends to explore and understand the phenomenon of mathematics test anxiety.

Title of the research study:

EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY

Researcher:

Timara Wyngaard

Purpose of the study:

The aim of the study is to explore the phenomenon of test anxiety within the field of mathematics as experienced by adolescent learners in grade 10. Factors that might contribute to the experience of anxiety related to evaluations in mathematics, as well as instances when anxiety does not influence aforementioned evaluations will also be explored.

Research instrument:

An individual interview (approximately 30 minutes) will be conducted with each grade 10 participant. All these learners will partake in a collaborative drawing activity (approximately 60 minutes).

An in-depth interview (approximately 50 minutes) will be held with the grade 10 mathematics teacher.

Confidentiality:

Any information that is obtained in connection with this study will be engaged with in a dignified and respectful manner. Such information will remain confidential within the fellowship of the research participants. Beyond these contextual boundaries their identities will remain confidential and will be disclosed only with the permission of the participant or as required by law.

Confidentiality will be maintained by means of coding procedures whereby participants are assigned codes instead of their real names, all electronic data will be password protected once stored and hard copies will be kept in a safe. My study supervisor, Mrs. Mariechen Perold and I will be the only individuals with access to the data. In addition to me, she also requires access to the data to ensure it is handled in an ethical manner.

The information gathered will form part of a thesis to which others will have access for academic purposes. Neither the names nor the identities of any participant, or the school involved will be disclosed in the final thesis.

Participants may, at any point during the research process, withdraw from the study with no adverse consequences to themselves.

Identification of the research personnel:

Should your have any questions or would like to raise concerns about the research, feel free to contact:

Principle Investigator: Timara Wyngaard on 0767409229 or at w.timara@gmail.com

Supervisor: Mariechen Perold on 0218082307 or at mdperold@sun.ac.za

Yours sincerely

_____ _____

Timara Wyngaard Date

Researcher

SIGNITURE OF PRINCIPAL

The aforementioned information was sufficiently explained to me by the researcher, Timara Wyngaard. I was provided with the opportunity to pose questions, which in turn were answered to my satisfaction.

I hereby consent to the completion of the proposed study at _____.

_____

Name of Principal

_____ _____

Signature of Principal Date

ADDENDUM D

INFORMED CONSENT FORM AS PROVIDED TO LEARNER-PARTICIPANTS

STELLENBOSCH UNIVERSITY

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:

Exploring grade 10 learners' mathematics test anxiety

RESEARCHER'S NAME: Timara Wyngaard

ADDRESS: Departmental Administrator
Educational Psychology
Faculty of Education
Private Bag X1
Matieland 7602

CONTACT NUMBER: 0218082307

EMAIL ADDRESS: w.timara@gmail.com

What is RESEARCH?

Research is something we do to find new knowledge about the way things and people work. In this instance we aim to use a research project to find ways of understanding and supporting learners who might experience academic difficulties.

What is this research project all about?

This research is about finding out how learners feel before and during writing a mathematics test and what makes learners anxious when they have to write a maths test.

Why have I been invited to take part in this research project?

You have been invited to take part in this research project because you are in Grade 10, you chose to take mathematics as one of your school subjects, and I would like to know what your experiences of anxiety surrounding maths tests are.

Who is doing the research?

I'm a student registered for the Masters in Educational Psychology programme at Stellenbosch University. My studies are aimed at helping adolescents like you with school related difficulties. When I was in high school, I really struggled with maths and I wished there was someone who could help me feel better about doing the subject and be less anxious when I had to write a maths test. This is why I'm doing this research project – to hopefully help you find ways in which to help yourself be less anxious about maths tests.

What will happen to me in this study?

Should you decide to partake in the study, the following will happen:

1. I will have a short interview with you during which we will discuss your experience (or not) of anxiety with regard to maths tests. The interview will be audiotaped in order to be transcribed at a later time.
2. All the participants will partake in a group activity during which a big drawing will be made which represents how you feel about maths tests and exams.
3. I shall interview your mathematics teacher.
4. I would like to be able to look at your mathematics results in your school reports since the beginning of grade 8.

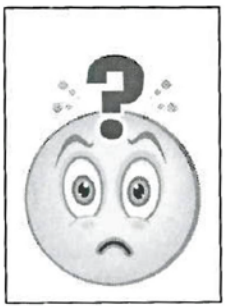
Can anything bad happen to me?

A person might become emotional when talking about experiences of anxiety. Should this happen, I shall arrange that you speak to the school psychologist, Celeste Coetsee, about the matter.

Can anything good happen to me?

When sharing your experiences of test anxiety you may become aware of instances when you or fellow participants (your classmates) are less anxious and in that way identify helpful skills to assist in lessening your anxiety. This in turn may have a positive influence on your performance.

Will anyone know I am in the study?



Your parents, mathematics teacher and fellow classmates who also decide to take part in the study will be aware of your participation. Beyond this context your identity will remain confidential.

The only other person who will know about the participants in the study will be my supervisor (Ms M. Perold), who is guiding me in this research project.

Who can I talk to about the study?

Should you have any questions about the study, feel free to contact me. My details are listed above.

You may also contact my supervisor. Her details are as follow:
Ms Mariechen Perold
mdperold@sun.ac.za
0218082307/6

What if I do not want to do this?

The final decision remains yours; however, I would appreciate your participation. Even if your parents agree and you don't want to do it, then you don't have to. Also, if you agree and later on change your mind, you may withdraw from the study without getting into trouble. No-one can force you to take part.

Mark the appropriate box with an X:

Do you understand this research study and are you willing to take part in it?

YES NO

Has the researcher answered all your questions?

YES NO

Do you understand that you can pull out of the study at any time?

YES NO

_____ _____

Signature of Participant Learner Date

ADDENDUM E

INFORMED CONSENT FORM AS PROVIDED TO LEARNER-PARTICIPANTS' PARENTS

UNIVERSITEIT•STELLENBOSCH•UNIVERSITY

STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY
Consent form for population group: Parent(s)

Your child is asked to participate in a research study conducted by Timara Wyngaard, a Maters student in Educational Psychology at Stellenbosch University. The research will contribute to my thesis. Your child was selected as a possible participant in this study because I would like to enquire about his/her experiences of anxiety before, during and after mathematics tests.

1. PURPOSE OF THE STUDY

The study aims to explore learners' experiences of test anxiety in mathematics. Factors such as what makes learners anxious, how they experience anxiety and under which circumstances they are less anxious will be addressed.

2. PROCEDURES

If you give consent for your child's participation in this study, he/she would be asked to do the following:

Interview – Partake in a brief individual interview during which we will discuss matters surrounding their experience of test anxiety pertaining to mathematics. The interview will be audiotaped in order to be transcribed at a later stage.

Group activity – All participants will contribute toward making a visual representation in the form of a drawing that represents their emotions and thoughts around mathematics and test anxiety.

Length of time for participation:
Interview: 30 minutes
Group activity: 45 minutes to an hour

Frequency of procedures:
Interview: once
Group activity: once

Location of the procedures to be done: At school.

The provision of access to your child's school reports since the beginning of Grade 8 in order to track his/her performance in mathematics evaluations.

3. POTENTIAL RISKS AND DISCOMFORTS

Your child may experience some emotional discomfort when discussing their feelings and experiences of anxiety. Should this occur and they feel the need to, arrangements will be made for them to consult the school psychologist, Celeste Coetsee.

4. POTENTIAL BENEFITS TO THE PARTICIPANT AND/OR TO SOCIETY

Through their participation your child may become aware of instances when they or fellow participants are less anxious. In this manner they may be able to identify helpful skills to assist in lessening their anxiety. This in turn may have a positive influence on their performance. On a broader level, the findings yielded by the study will possibly add to the existing body of scientific knowledge available on the topic of mathematics test anxiety.

5. PAYMENT FOR PARTICIPATION

Your child, nor you, will receive payment for participating in the research study.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study will be engaged with in a dignified and respectful manner. Such information will remain confidential within the fellowship of the research participants. Beyond these contextual boundaries your child's identity will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of coding procedures whereby participants are assigned codes instead of their real names, all electronic data will be password protected once stored and hard copies will be kept in a safe. My study supervisor, Ms. Mariechen Perold and I will be the only individuals with access to the data. In addition to me, she also requires access to the data to ensure it is handled in an ethical manner.

Participants have the right to access, edit and review activities that are audio- or videotaped during the data collection process. Such records will be erased after a period of five years has lapsed.

7. PARTICIPATION AND WITHDRAWAL

You and your child can choose whether to be in this study or not. If your child volunteers to be in this study, they may withdraw at any time without consequences of any kind. They may also refuse to answer any questions they don't want to answer and still remain in the study. The investigator may withdraw them from this research if circumstances arise which warrant doing so.

8. IDENTIFICATION OF INVESTIGATORS

If you have any questions or concerns about the research, please feel free to contact the research personnel.

Principal Investigator: Timara Wyngaard on 0767409229 or at w.timara@gmail.com
Supervisor: Mariechen Perold on 0218082307 or at mdperold@sun.ac.za

Should there be a need to seek therapeutic guidance; the school psychologist can be contacted via the school's secretary. Names and contact details will be provided once the school has been finalised.

9. RIGHTS OF RESEARCH PARTICIPANTS

You and your child may withdraw your consent at any time and discontinue participation without penalty. They are not waiving any legal claims, rights or remedies because of their participation in this research study. If you have questions regarding your rights as a research participant, contact Ms Maléne Fouché [mfouche@sun.ac.za; 021 808 4622] at the Division for Research Development at Stellenbosch University.

SIGNATURE OF RESEARCH PARTICIPANT: PARENT

The information above was provided to me by Timara Wyngaard in a language I understood. I was given the opportunity to ask questions, and if necessary, these questions were answered to my satisfaction.

I, _____, hereby consent to my child's voluntary participation in this study. I have been given a copy of this form.

_____ _____

Name of Participant **Date**

SIGNATURE OF INVESTIGATOR (RESEARCHER)

I declare that I explained the information given in this document to _____ and that he/she was encouraged and given ample time to ask me any questions.

_____ _____

Timara Wyngaard (Researcher) **Date**

ADDENDUM F

INFORMED CONSENT FORM AS PROVIDED TO TEACHER-PARTICIPANT

UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot · your knowledge partner

STELLENBOSCH UNIVERSITY
CONSENT TO PARTICIPATE IN RESEARCH

EXPLORING GRADE 10 LEARNERS' MATHEMATICS TEST ANXIETY
Consent form for population group: Mathematics teacher

I am Timara Wyngaard, a Masters student in Educational Psychology at Stellenbosch University. I would like to ask you to participate in a research study that will contribute to my thesis. You were selected as a possible participant in this study because you are deemed a valuable source of knowledge to help me to understand learners who experience test anxiety in your mathematics class when being evaluated in Mathematics.

1. PURPOSE OF THE STUDY

The study aims to explore learners' experiences of test anxiety in mathematics. Factors such as what makes them anxious, how they experience anxiety and under which circumstances they are less anxious, will be addressed.

2. PROCEDURES

If you volunteer to participate in this study, you will be asked to do the following: Avail yourself for an individual interview of approximately 50 minutes during which we will discuss the phenomenon of and dynamics surrounding mathematics test anxiety. The interview will take place at the school at a time that is convenient for you.

3. POTENTIAL RISKS AND DISCOMFORTS

No foreseeable risks, discomforts, and inconveniences, are envisaged for you.

Emotional reactions in the learners during the research activities will be contained should it happen, by referring the learners to the school psychologist.

4. POTENTIAL BENEFITS TO THE PARTICIPANT AND/OR TO SOCIETY

Through your participation in the study you may become aware of the manifestations of test anxiety within your mathematics classroom. Being cognisant of learner anxiety may enable you to address the matter in an attempt at lessening the effects of anxiety on the learners in your classroom. This in turn may cause the learners in your class to achieve better results. On a broader level, the findings yielded by the study will possibly add to the existing body of scientific knowledge available on the topic of mathematics test anxiety.

SIGNATURE OF RESEARCH PARTICIPANT: TEACHER

The information above was provided to me by Timara Wyngaard in a language I understood. I was given the opportunity to ask questions, and if necessary, these questions were answered to my satisfaction.

I, _____, hereby consent to the voluntary participation in this study. I have been given a copy of this form.

_____ _____

Name of Participant **Date**

SIGNATURE OF INVESTIGATOR (RESEARCHER)

I declare that I explained the information given in this document to _____ and that he/she was encouraged and given ample time to ask me any questions.

_____ _____

Timara Wyngaard (Researcher) **Date**

ADDENDUM G

LEARNERS' INTERVIEW SCHEDULE

INTERVIEW SCHEDULE: LEARNERS

The focus will be on the learners' experiences and understandings of mathematics test anxiety. The sub-themes that will contribute to aforementioned focus of exploration will be:

1. Knowledge and/or experience of anxiety (symptoms as in General Anxiety Disorder and Panic Disorder).
   - Excessive anxiety and worry, occurring more days than not for at least 6 months, about a number of events or activities.
   - Difficulty in controlling the worry.
   - The anxiety and worry is associated with: restlessness of feeling keyed up or on edge; being easily fatigued; difficulty concentrating or mind going blank; irritability; muscle tension; sleep disturbance.
   - The anxiety, worry, or physical symptoms cause significant distress in important areas of functioning.
   - The disturbance is not attributable to the physiological effects of a substance or another medical condition.
   - Recurrent unexpected panic attacks during which the following symptoms occur: palpitations, pounding heart, or accelerated heart rate; sweating; trembling or shaking; chest pain or discomfort; nausea or abdominal distress; feeling dizzy, unsteady, light-headed, or faint; chills or heat sensations; paresthesias (numbness or tingling sensations); derealisation (feelings or unreality) or depersonalisation (being detached from oneself); fear of losing control or "going crazy"; and fear of dying.
2. Knowledge and/or experience of general test taking anxiety.
3. Experiences of anxiety pertaining to tests in mathematics prior to, during and after evaluations.
4. Sources of mathematics test anxiety:
   - Concerns about how others will view you if you do poorly
   - Concerns about your own self-image
   - Concerns about not being prepared for a test
   - Concerns about your future security
5. Expressions of mathematics test anxiety:
   - Bodily reactions
   - Thought disruptions
6. Impact of test anxiety on mathematics results.
7. Instances when anxiety does not influence evaluations in mathematics.

ADDENDUM H

TEACHER'S INTERVIEW SCHEDULE

INTERVIEW SCHEDULE: TEACHER

The focus will be on the grade 10 mathematics class teacher's understanding of the learners' experiences of mathematics test anxiety. The sub-themes that will contribute to aforementioned focus of exploration will be:

1. Knowledge and/or witnessing of anxiety in learners (symptoms as in General Anxiety Disorder and Panic Disorder).
   - Excessive anxiety and worry, occurring more days than not for at least 6 months, about a number of events or activities.
   - Difficulty in controlling the worry.
   - The anxiety and worry is associated with: restlessness of feeling keyed up or on edge; being easily fatigued; difficulty concentrating or mind going blank; irritability; muscle tension; sleep disturbance.
   - The anxiety, worry, or physical symptoms cause significant distress in important areas of functioning.
   - The disturbance is not attributable to the physiological effects of a substance or another medical condition.
   - Recurrent unexpected panic attacks during which the following symptoms occur: palpitations, pounding heart, or accelerated heart rate; sweating; trembling or shaking; chest pain or discomfort; nausea or abdominal distress; feeling dizzy, unsteady, light-headed, or faint; chills or heat sensations; paresthesias (numbness or tingling sensations); derealisation (feelings or unreality) or depersonalisation (being detached from oneself); fear of losing control or "going crazy"; and fear of dying.
2. Knowledge and/or witnessing of general test taking anxiety.
3. Witnessing of anxiety pertaining to tests in mathematics prior to, during and after evaluations.
4. Sources of mathematics test anxiety:
   - Concerns about how others will view you if you do poorly
   - Concerns about your own self-image
   - Concerns about not being prepared for a test
   - Concerns about your future security
5. Expressions of mathematics test anxiety:
   - Bodily reactions
   - Thought disruptions
6. Impact of test anxiety on mathematics results.
7. Instances when anxiety does not influence evaluations in mathematics.

ADDENDUM I

EXCERPT FROM A TRANSCRIPT

DEELNEMER NO. 6

Timara	Ok. In die algemeen bekommer jy jou dikwels oor dinge?	**Comment [T1]:** affect
Deelnemer 6	Nie rerig nie.	**Comment [T2]:** affect
Timara	Nie rerig nie, nou wat maak dat jy nie iemand is wat regtig bekommerd is nie?	
Deelnemer 6	Ek weet nie, ek is baie rustig half, soos ek sal nie, ek sal nie soos voor 'n toets baie erg stres nie maar sodra ek iets sien in die toets wat ek nie weet hoe om te doen nie(? 00.31)	**Comment [T3]:** affect **Comment [T4]:** reasons to worry
Timara	ja	
Deelnemer 6	dan sal ek begin soos bekommerd raak.	**Comment [T5]:** affect
Timara	Daardie oomblikke wat daardie gebeur,	
Deelnemer 6	ja	
Timara	hoe voel jy dan?	
Deelnemer 6	As ek dit sien?	
Timara	Ja	
Deelnemer 6	Ek voel soos dan soos die goed wat ek dan kan doen so sukkel ek dan om te doen en ek vergeet goed wat ek gedoen het en geleer het en so.	**Comment [T6]:** affect
Timara	So daardie paar goedjies, een dingetjie of 'n paar goedtjies	
Deelnemer 6	ja	
Timara	wat nou vir jou 'n bietjie afgooi want jy het dit nie verwag nie, of dit is moeiliker as wat jy gedink het, het dan eintlik 'n negatiewe impak op dit wat jy alles doen?	**Comment [T7]:** impact on marks
Deelnemer 6	Ja, wat ek ken en kan doen.	**Comment [T8]:** impact on marks
Timara	Ok. As jy nou dink spesifiek aan wiskunde toetse, hoe is jy geneig om voor 'n wiskunde toets te voel?	
Deelnemer 6	Ek voel half angstig en as ek weet ek het nie heeltemal soos goed genoeg of hard genoeg geleer nie	**Comment [T9]:** affect (and actions)
Timara	ja	
Deelnemer 6	en dan veral of al het ek geleer en ek weet ek kan die goed doen voel ek nog steeds soos ek gaan sukkel of daar gaan iets wees wat ek nie kan doen nie.	**Comment [T10]:** affect (and actions)

1/Deelnemer 6

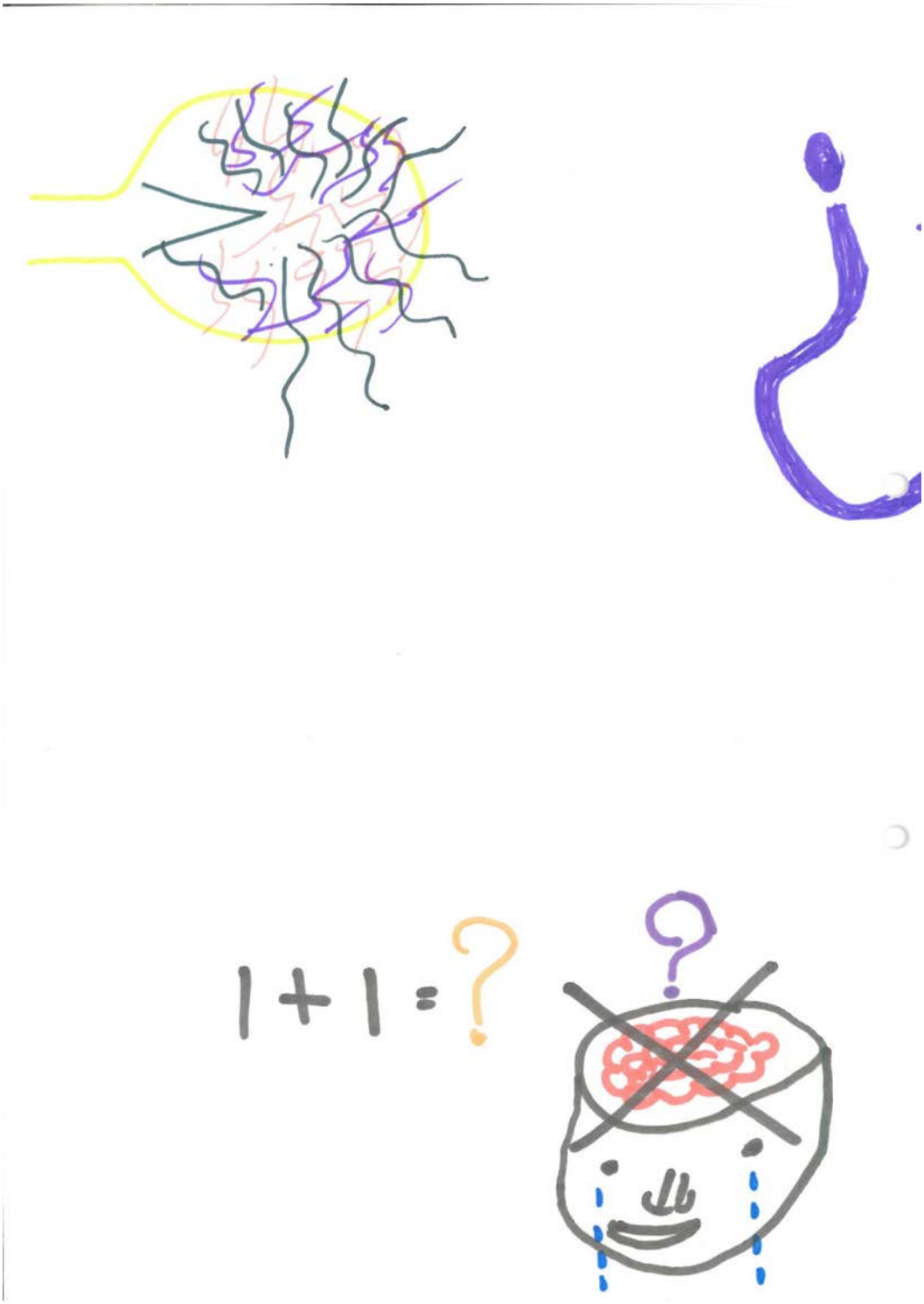
Timara	Nou, jy het vir my nou-nou net gesê in die algemeen stres jy nie so baie nie, met wiskunde het jy gesê jy stres voor 'n wiskunde toets, is dit dat jy in die algemeen oor wiskunde 'n bietjie meer stres as jou ander vakke?	**Comment [T11]:** affect
Deelnemer 6	Ja baie	**Comment [T12]:** affect
Timara	Hoekom dink jy stres jy meer oor wiskunde?	
Deelnemer 6	Want daar is baie goed wat ek nie kan doen nie, so dan ja.	**Comment [T13]:** reasons to worry
Timara	Dan maak dit vir jou dinge moeiliker en obviously stres jy dan meer?	
Deelnemer 6	Ja	
Timara	Nou dink nou jouself in, jy is nou in die klas, jy het die wiskunde vraestel voor jou, julle skryf nou toets, hoe voel jy? Wat is die dinge waaraan jy dink?	
Deelnemer 6	Uhm ek weet nie, uhm ek dink soos, ek weet nie, ek, my, ek konsentreer nie altyd as ek wiskunde skryf nie, konsentreer ek nie altyd nie of ek kan nie altyd baie goed konsentreer op die toets nie, so ek dink aan baie goed altyd.	**Comment [T14]:** cognitive effects
Timara	Is daar gedagtes soos uhm "ek kan dit nie doen nie",	**Comment [T15]:** cognitive effects
Deelnemer 6	ja	**Comment [T16]:** cognitive effects
Timara	of "ek is nie goed genoeg om dit te doen nie", of "ek het nie hard genoeg geleer nie?"	**Comment [T17]:** cognitive effects **Comment [T18]:** cognitive effects
Deelnemer 6	Ja	**Comment [T19]:** cognitive effects
Timara	Dis soms die dingetjies waaraan jy dink?	
Deelnemer 6	Ja	
Timara	Nou as jy met die vraestel voor jou sit en dit is die goed waaraan jy dink maak dit dat jy nie fokus op dit wat hier voor jou is nie en dan dink jy aan ander random goeters?	**Comment [T20]:** cognitive effects
Deelnemer 6	Ja	**Comment [T21]:** cognitive effects
Timara	Ok, en as die wiskunde toets nou verby is, hoe voel jy dan?	
Deelnemer 6	Ek voel verlig soos ek kan weer aangaan	**Comment [T22]:** affects
Timara	ja	
Deelnemer 6	soos normaal, dis verby.	**Comment [T23]:** affect
Timara	Asemhaal, dis verby.	
Deelnemer 6	Die punte mag nou nie so goed lyk nie, maar dis verby.	

Timara	Dit is wat ek volgende wou vra, is dit dat jy voel ok ek kan nou weer asemhaal dis verby maar 'n deel van jou stres want jy weet nie hoe jy gaan doen nie?	
Deelnemer 6	Ek stres as die juffrou so sê sy gaan nou ons toetse vir ons uitdeel want ek verwag altyd die ergste want ek weet dit gaan nie goed gaan nie, maar soos nadat ek geskryf het sal ek nie soos vir 'n lang tyd nog daarna daaraan dink of stres daaroor nie, soos daardie dag wanneer ons die toets terug kry dan begin ek te stres.	**Comment [T24]:** affects **Comment [T25]:** expectations and pressure **Comment [T26]:** affect
Timara	En wat gebeur gewoonlik as jy nou jou uitslae kry is dit so erg soos wat jy gedink het of is dit nie so erg nie?	**Comment [T27]:** impact on marks
Deelnemer 6	Partykeer is dit nie so erg nie, maar dit was nog nooit erger as wat ek gedink het dit sou wees nie.	**Comment [T28]:** impact on marks
Timara	Ok, en as jy nou dink die kere wat jy nie so goed gedoen het in wiskunde nie omdat jy angstig was, hoe laat dit jou voel oor jouself? Is jy teleurgesteld in jouself, voel jy jy het nie so goed gedoen soos wat jy kan nie of voel jy "ag wat dit is nou verby dit is hoe dit is"?	
Deelnemer 6	Ja ek voel half so en partykeer voel ek half teleurgesteld omdat ek weet ek kon nog harder geleer het en ek kon nog beter gedoen het maar ja	**Comment [T29]:** affect
Timara	dis nou verby	
Deelnemer 6	dis nou verby en daar is niks wat ek nou daaraan kan doen nie.	**Comment [T30]:** coping mechanism
Timara	Ja. Maak dit vir jou saak wat ander mense dink? Hoe jy doen in wiskunde?	**Comment [T31]:** others' perceptions
Deelnemer 6	Nie rerig nie.	**Comment [T32]:** others' perceptions
Timara	So dit maak nie vir jou saak wat jou onderwyser of jou ouers	
Deelnemer 6	dit doen nogal vir my onderwyser en my ouers want ek voel ek het hulle teleurgestel as ek swak doen so en dan, ja.	**Comment [T33]:** others' perceptions
Timara	Is dit soms dat jy dink jy vergelyk jou punte met jou maats sin?	**Comment [T34]:** comparison with others
Deelnemer 6	Nee nie rerig nie	**Comment [T35]:** comparison with others
Timara	Nie rerig nie.	
Deelnemer 6	Nee	
Timara	Uhm en die kere wat jy wel stres in die klas, jy het gesê jy konsentreer nie, jy dink oor ander dinge. As jy dink hoe jou liggaam voel, fisies, is dit dat jou hart vinniger klop of jou hande voel sweterig of jy het hoofpyn, of jy kon nie goed slaap nie want jy het gestres daaroor. Voel jy enige sulke goed?	**Comment [T36]:** physiological effect
Deelnemer 6	Nie rerig nee.	**Comment [T37]:** physiological effect
Timara	Nie regtig nie.	

3/Deelnemer 6

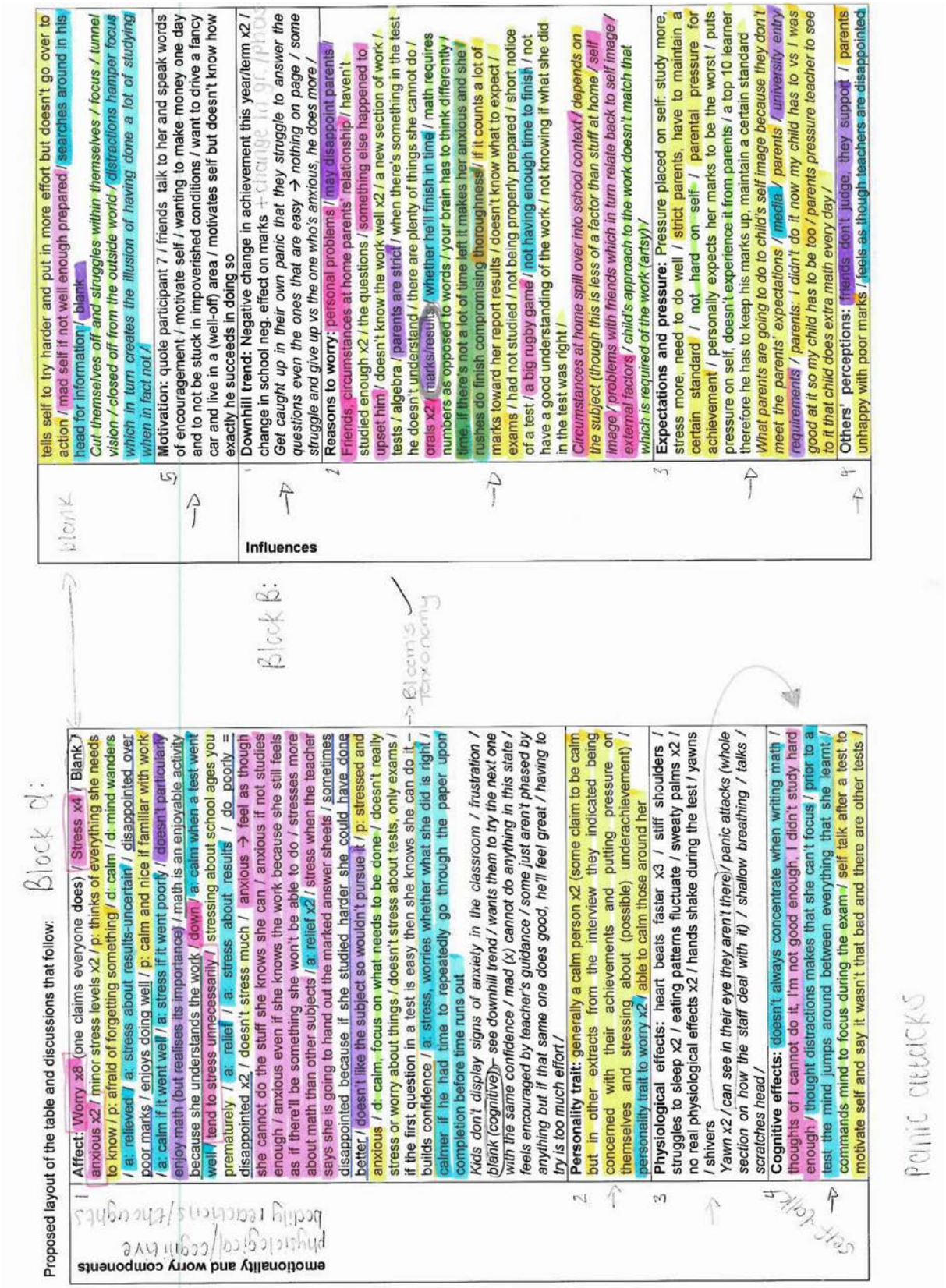
ADDENDUM J

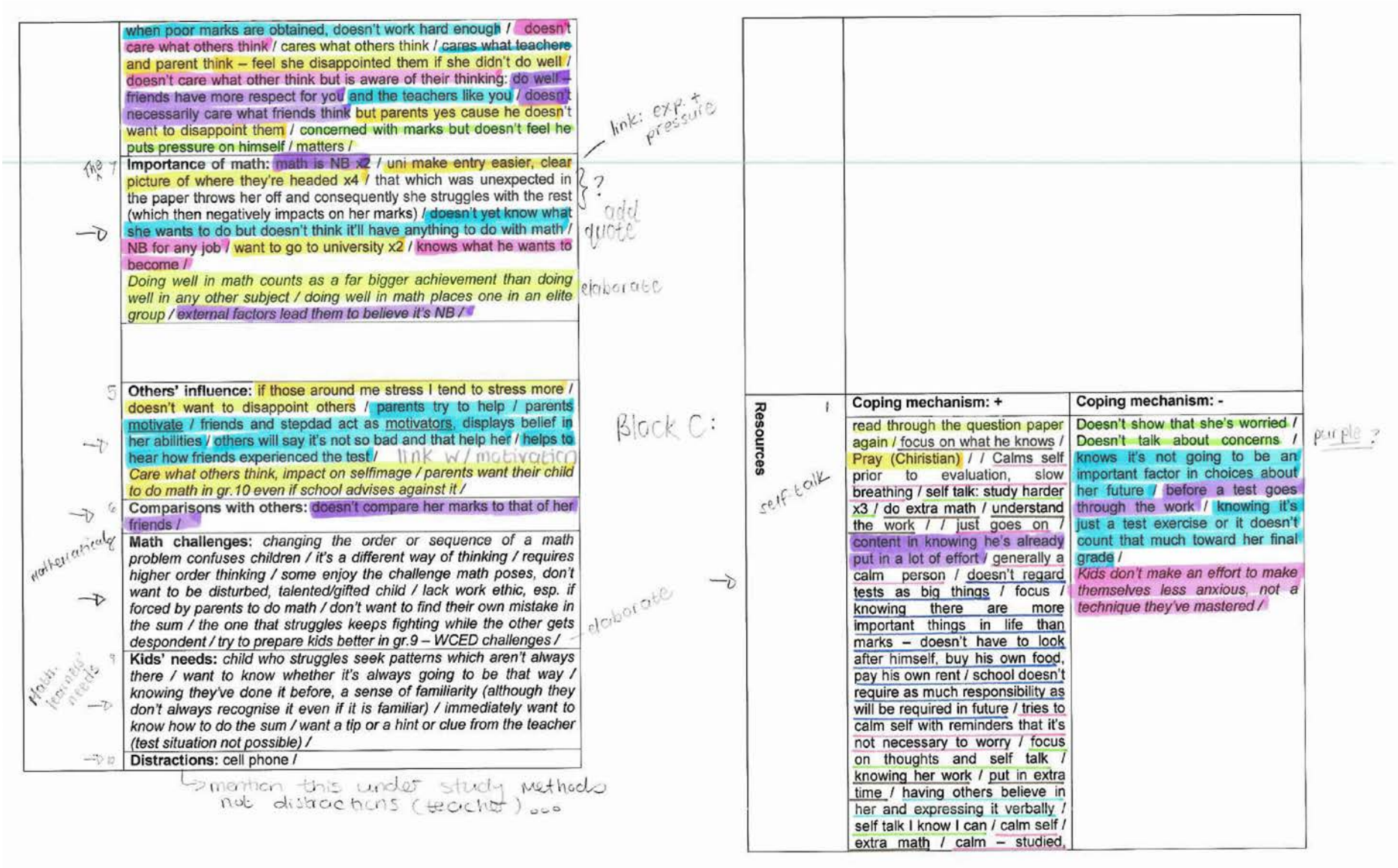
EXCERPT FROM CREATIVE DRAWING EXCERCISE



ADDENDUM K

EXCERPT FROM DATA-ANALYSIS





when poor marks are obtained, doesn't work hard enough / doesn't care what others think / cares what others think / cares what teachers and parent think – feel she disappointed them if she didn't do well / doesn't care what other think but is aware of their thinking: do well – friends have more respect for you and the teachers like you / doesn't necessarily care what friends think but parents yes cause he doesn't want to disappoint them / concerned with marks but doesn't feel he puts pressure on himself / matters /

link: exp. + pressure

Importance of math: math is NB x2 / uni make entry easier, clear picture of where they're headed x4 / that which was unexpected in the paper throws her off and consequently she struggles with the rest (which then negatively impacts on her marks) / doesn't yet know what she wants to do but doesn't think it'll have anything to do with math / NB for any job / want to go to university x2 / knows what he wants to become /

Doing well in math counts as a far bigger achievement than doing well in any other subject / doing well in math places one in an elite group / external factors lead them to believe it's NB /

? add quote

elaborate

Others' influence: if those around me stress I tend to stress more / doesn't want to disappoint others / parents try to help / parents motivate / friends and stepdad act as motivators, displays belief in her abilities / others will say it's not so bad and that help her / helps to hear how friends experienced the test / link w/ motivation

Care what others think, impact on selfimage / parents want their child to do math in gr.10 even if school advises against it /

Comparisons with others: doesn't compare her marks to that of her friends /

Math challenges: *changing the order or sequence of a math problem confuses children / it's a different way of thinking / requires higher order thinking / some enjoy the challenge math poses, don't want to be disturbed, talented/gifted child / lack work ethic, esp. if forced by parents to do math / don't want to find their own mistake in the sum / the one that struggles keeps fighting while the other gets despondent / try to prepare kids better in gr.9 – WCED challenges /*

Kids' needs: *child who struggles seek patterns which aren't always there / want to know whether it's always going to be that way / knowing they've done it before, a sense of familiarity (although they don't always recognise it even if it is familiar) / immediately want to know how to do the sum / want a tip or a hint or clue from the teacher (test situation not possible) /*

Distractions: cell phone /

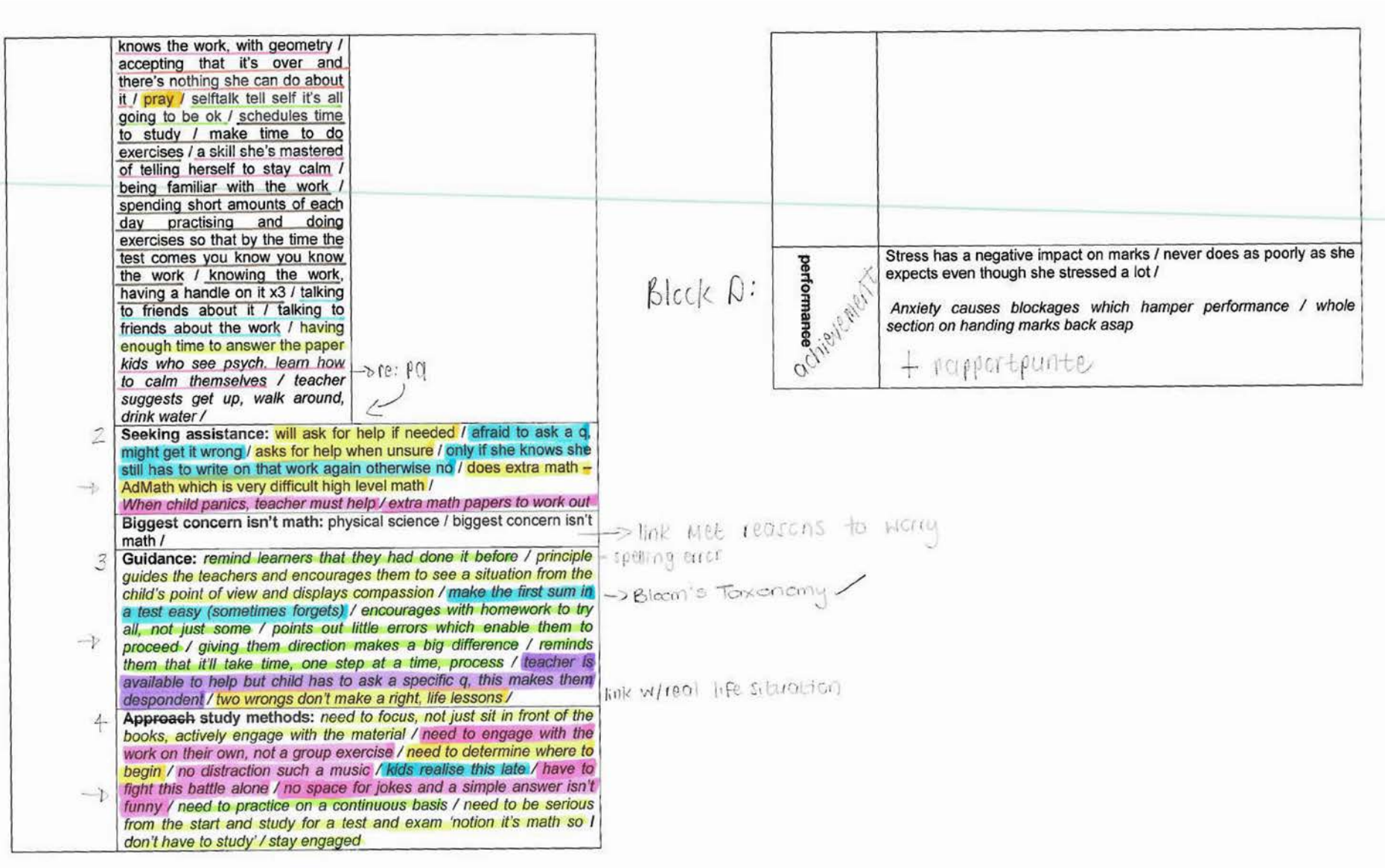
↳ mention this under study methods not distractions (teacher) ...

Block C:

elaborate

Resources	Coping mechanism: +	Coping mechanism: -
self-talk	read through the question paper again / focus on what he knows / Pray (Chiristian) / / Calms self prior to evaluation, slow breathing / self talk: study harder x3 / do extra math / understand the work / / just goes on / content in knowing he's already put in a lot of effort / generally a calm person / doesn't regard tests as big things / focus / knowing there are more important things in life than marks – doesn't have to look after himself, buy his own food, pay his own rent / school doesn't require as much responsibility as will be required in future / tries to calm self with reminders that it's not necessary to worry / focus on thoughts and self talk / knowing her work / put in extra time / having others believe in her and expressing it verbally / self talk I know I can / calm self / extra math / calm – studied,	Doesn't show that she's worried / Doesn't talk about concerns / knows it's not going to be an important factor in choices about her future / before a test goes through the work / knowing it's just a test exercise or it doesn't count that much toward her final grade / *Kids don't make an effort to make themselves less anxious, not a technique they've mastered /*

purple ?



knows the work, with geometry / accepting that it's over and there's nothing she can do about it / pray / selftalk tell self it's all going to be ok / schedules time to study / make time to do exercises / a skill she's mastered of telling herself to stay calm / being familiar with the work / spending short amounts of each day practising and doing exercises so that by the time the test comes you know you know the work / knowing the work, having a handle on it x3 / talking to friends about it / talking to friends about the work / having enough time to answer the paper *kids who see psych. learn how to calm themselves / teacher suggests get up, walk around, drink water /*

→ re: PQ

2 **Seeking assistance:** will ask for help if needed / afraid to ask a q, might get it wrong / asks for help when unsure / only if she knows she still has to write on that work again otherwise no / does extra math – AdMath which is very difficult high level math /
When child panics, teacher must help / extra math papers to work out

Biggest concern isn't math: physical science / biggest concern isn't math /

→ link MEE reasons to worry

3 **Guidance:** *remind learners that they had done it before / principle guides the teachers and encourages them to see a situation from the child's point of view and displays compassion / make the first sum in a test easy (sometimes forgets) / encourages with homework to try all, not just some / points out little errors which enable them to proceed / giving them direction makes a big difference / reminds them that it'll take time, one step at a time, process / teacher is available to help but child has to ask a specific q, this makes them despondent / two wrongs don't make a right, life lessons /*

- spelling error
→ Bloom's Taxonomy ✓

link w/real life situation

4 **~~Approach~~ study methods:** *need to focus, not just sit in front of the books, actively engage with the material / need to engage with the work on their own, not a group exercise / need to determine where to begin / no distraction such a music / kids realise this late / have to fight this battle alone / no space for jokes and a simple answer isn't funny / need to practice on a continuous basis / need to be serious from the start and study for a test and exam 'notion it's math so I don't have to study' / stay engaged*

Block A:

performance achievement	Stress has a negative impact on marks / never does as poorly as she expects even though she stressed a lot / *Anxiety causes blockages which hamper performance / whole section on handing marks back asap* + rapportpunte